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PROGRAM AND ABSTRACTS OF THE TWENTY-NINTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF PARASITOLOGISTS, MEMPHIS, TENNESSEE

November 3, 4, 5, 6, 1954

PROGRAM[1]

WEDNESDAY AFTERNOON SESSION, NOVEMBER 3, 2:00 P.M., CADET ROOM, PEABODY HOTEL. D. V. MOORE, NEW YORK UNIVERSITY COLLEGE OF MEDICINE, PRESIDING.

Read

(Presentation of papers limited to ten minutes)

1. *Anatrichosoma cynamolgi,* a new trichurid nematode from monkeys. (5 min.). W. N. SMITH, University of Maryland, AND M. B. CHITWOOD, U.S.D.A.

2. The development of *Ornithofilaria fallisensis* Anderson, 1954 in *Simulium venustum* Say. (10 min.) (2 by 2 lantern). R. C. ANDERSON, Ontario Research Foundation, Toronto, Canada. (Introduced by A. M. FALLIS).

3. Fluctuations in intensity of *Amidostomum* infection in a wintering population of Canada geese. (10 min.) (Standard lantern). C. M. HERMAN, Patuxent Research Refuge, and E. E. WEHR, U.S.D.A.

4. The pathogenic effect on lambs of a bovine strain of the stomach hairworm, *Trichostrongylus axei.* (10 min.) (Standard lantern). J. H. TURNER AND K. C. KATES, U.S.D.A.

5. Age of chickens and the rate of maturation of *Ascaridia galli.* (10 min.) (Standard lantern). K. B. KERR, Dr. Salsbury's Laboratories.

6. Immunodiagnosis of *Trichinella spiralis* in hogs by the use of the flocculation test. (10 min.). LOIS NORMAN AND E. H. SADUN, U.S.P.H.S. (Introduced by E. H. SADUN).

7. Factors in racial immunity of the white rat to cotton rat filarial worms. (10 min.) (Standard lantern). L. J. OLSEN, J. A. SCOTT, AND E. M. MACDONALD, The University of Texas Medical Branch at Galveston.

8. A statistical analysis of the growth in length of the filarial worms in the cotton rat. (10 min.) (Standard lantern). M. G. WESTBROOK AND J. A. SCOTT, The University of Texas Medical Branch at Galveston.

9. Improved yields in axenic fluid cultures of *Neoaplectana glaseri* (NEMATODA). (10 min.) (Standard lantern). N. R. STOLL, The Rockefeller Institute for Medical Research.

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[1] An alphabetical author-index will be found at the end of the program. Extra copies of this supplement, and portraits of parasitologists, will be on sale at the meeting.

10. The cultivation of the free-living stages of *Nippostrongylus muris* and *Necator americanus* in the absence of living bacteria. (10 min.) (Standard lantern). P. B. WEINSTEIN, N.I.H.

11. Chemical evidence of an excretory function for the so-called excretory system of the filariform larva of *Nippostrongylus muris*. (10 min.) (Standard lantern). P. B. WEINSTEIN AND W. T. HASKINS, N.I.H.

12. Nematocidal screening tests of cadmium compounds against horse strongyle larvae. (10 min.) (Standard lantern). N. D. LEVINE AND VIRGINIA IVENS, University of Illinois.

13. The rate of consumption of a 10 to 1 salt-phenothiazine mixture used in the control of parasites of cattle. (10 min.) (Standard lantern). R. L. MAYHEW, Louisiana State University.

14. The effect of various minerals on the growth of *Haemonchus contortus* larvae. (10 min.) (2 by 2 lantern). R. F. SHUMARD, North Dakota Agricultural College, AND C. A. HERRICK, University of Wisconsin.

15. Filarial parasites in mammals. (5 min.). D. L. PRICE, Army Medical Graduate School. (Also by demonstration—see No. 74).

16. Diagnosis of *Physaloptera* in dogs by stool examination. (10 min.) (Standard lantern). F. A. EHRENFORD, Pitman-Moore Company.

17. Internal parasitism in monozygotic cattle twins. (10 min.). J. R. DOUGLAS, University of California at Davis.

By Title

18. Importance of the *Ascaridia galli* egg shell to the infectivity of its larvae. M. F. HANSEN AND D. S. TURNER, Kansas State College.

19. Observations on the anthelmintic action of carbon disulfide on the fowl ascarid, *Ascaridia galli* (Schrank). S. E. KNAPP AND M. F. HANSEN, Kansas State College.

20. The antigenic role of the excretions and secretions of *Trichinella spiralis* in the production of immunity in mice. C. H. CAMPBELL, University of North Carolina.

21. Some effects of altered oxygen tensions on certain plant-parasitic and soil-inhabiting nematodes *in vitro*. J. FELDMESSER AND W. A. FEDER, U.S.D.A.

22. The incidence and prepatent period of *Ancylostoma caninum* and *Toxocara canis* in prenatally infected puppies. L. M. YUTUC, University of the Philippines.

23. An investigation on the seasonal fluctuations of ascariasis in a region of high endemicity. L. P. FRICK, H. C. RUSSELL, AND L. S. RITCHIE, 406th Medical General Laboratory, APO 500.

24. The incidence of certain helminth parasites of the cat. C. O. BAUGHN AND A. BLIZNICK, American Cyanamid Co.

25. Parasites of the Amphibia. A. C. WALTON, Knox College.

WEDNESDAY EVENING, NOVEMBER 3, 7:00 P.M., ROOM 215, PEABODY HOTEL. DINNER AND COUNCIL MEETING, OFFICERS AND MEMBERS OF THE SOCIETY'S COUNCIL.

(All past Presidents of the Society are cordially invited to attend both the dinner and the meeting).

THURSDAY MORNING SESSION, NOVEMBER 4, 9:00 A.M. CADET ROOM, PEABODY HOTEL, P. C. BEAVER, TULANE UNIVERSITY, PRESIDING.

Read

(Presentation of papers limited to ten minutes)

26. The enteric Protozoa of laboratory golden hamsters. (10 min.) (Standard lantern). L. H. SAXE, The State University of Iowa.

27. Protozoan parasites of the chinchilla in the southeastern United States. (10 min.) F. A. HAYES AND R. E. THORSON, Alabama Polytechnic Institute.

28. Plasma protein variations in *Trypanosoma lewisi* infected rats and the effects of salicylate treatment on these variations. (10 min.) (Standard lantern). W. M. MEYERS AND M. G. LYSENKO, University of Wisconsin.

29. The metabolism of the culture form of *Trypanosoma gambiense*. (10 min.) (Standard lantern). T. VON BRAND, E. C. WEINBACH, AND E. J. TOBIE, National Institutes of Health.

30. Observations on toxoplasmosis in dogs. (10 min.) (Standard lantern). L. JACOBS, M. L. MELTON, AND M. K. COOK, National Institutes of Health.

31. Further observations on the growth of *Toxoplasma gondii* in roller tube tissue cultures. (10 min.). (Standard lantern). E. CHERNIN AND T. H. WELLER, Harvard University.

32. Variables encountered during studies on the energy metabolism of *Trichomonas vaginalis*. (10 min.) (Standard lantern). C. P. READ AND A. ROTHMAN, University of California at Los Angeles and The Johns Hopkins University.

33. Studies on the amoeba-bacteria relationships in amoebiasis. Comparative results of the intracecal inoculation of germ-free, monocontaminated and conventional guinea pigs with *Endamoeba histolytica*. (10 min.) (Standard lantern). B. P. PHILLIPS, P. A. WOLFE, C. M. REES, H. A. GORDON, W. H. WRIGHT, AND J. REYNIERS, National Institutes of Health and the University of Notre Dame.

34. Glucosamine in the culture of *Endamoeba histolytica* with a mixed bacterial flora. (10 min.) (Standard lantern). J. GREENBERG, D. J. TAYLOR, AND H. W. BOND, National Institutes of Health.

35. Comparative effects of oxygen upon parasitic and small free-living amoebae. (10 min.) (Standard lantern). W. BALAMUTH AND M. BRENT, University of California at Berkeley.

36. The effectiveness of the PVA-fixative technique in revealing intestinal amoebae in diagnostic cultures. (10 min.) (2 by 2 lantern). LOIS NORMAN AND M. M. BROOKE, Communicable Disease Center, Atlanta, Georgia.

37. Hyperactivity of metachloridine on *Plasmodium gallinaceum* in chicks maintained on a defined diet. (10 min.) (Standard lantern). D. J. TAYLOR AND J. GREENBERG, National Institutes of Health.

38. Studies on glycogen synthesis in white rats infected with *Plasmodium berghei*. (10 min.) (Standard lantern). T. VON BRAND AND T. I. MERCADO, National Institutes of Health.

39. Preparation and agglutination of merozoite suspensions of the chicken coccidian, *Eimeria tenella*. (10 min.) (Standard lantern). J. J. MCDERMOTT AND L. A. STAUBER, Rutgers University.

40. The effects of cecal coccidiosis on the ability of chickens to do muscular work. (10 min.) (Standard lantern). L. LEVINE AND C. A. HERRICK, University of Wisconsin.

41. A field strain of *Eimeria tenella* resistant to sulfonamides. (10 min.) (Standard lantern). E. WALETZKY, R. NEAL, AND I. HABLE, American Cyanamid Co.

42. Efficacy of furazolidone, a new nitrofuan, against blackhead and coccidiosis. (10 min.) (Standard lantern). P. D. HARWOOD AND D. I. STUNZ, Dr. Hess and Clark, Inc.

43. Cytochemistry of the macrogametocyte and unsporulated oocyst of *Eimeria brunetti* and *E. acervulina.* (10 min.) (Standard lantern). W. H. PATTILLO AND E. R. BECKER, Iowa State College.

Read by Title

44. Results of placing single trichomonads (*T. gallinae*) in the mouths of pigeons. R. M. STABLER AND J. T. KIHARA, Colorado College.

45. Evaluation of the susceptibility of *Trichomonas vaginalis* infections to systemic medication. C. SWARTZWELDER, J. G. MULÉ, W. W. FRYE, AND F. VELLA, Louisiana State University, School of Medicine.

45a. The severity of cecal coccidiosis infection in chickens as related to the age of the host and the number of oocysts ingested. J. L. GARDINER, U.S.D.A.

45b. Blackhead of turkeys primarily transmitted through cecal worm eggs. E. E. WEHR, U.S.D.A.

46. Parasites of the Amphibia. Protozoa. A. C. WALTON, Knox College.

THURSDAY AFTERNOON SESSION, NOVEMBER 4, 1954—2:00 P. M.
BALLROOM, PEABODY HOTEL

JOINT MEETING OF THE AMERICAN SOCIETY OF TROPICAL MEDICINE AND HYGIENE AND OF THE AMERICAN SOCIETY OF PARASITOLOGISTS.

SYMPOSIUM: SCHISTOSOMIASIS. DONALD B. MCMULLEN, ARMY MEDICAL SERVICE GRADUATE SCHOOL, VICE-PRESIDENT, A.S.P., PRESIDING.

47. Introduction to Schistosomiasis Symposium. (10 min.) D. B. MCMULLEN, Army Medical Service Graduate School.

48. Biology of the Schistosome Complexes. (20 min.). R. E. KUNTZ, National Naval Medical Center.

49. Natural History and Control of the Aquatic Snails that Transmit the Schistosomes of Man. (20 min.). L. J. OLIVIER, National Institutes of Health.

50. The Biology and Control of the Amphibious Snails that Serve as Intermediate Hosts for *Schistosoma japonicum.* (20 min.). L. S. RITCHIE, 406th Medical General Laboratory.

51. Immunological Aspects of *Schistosoma mansoni* Infections. (20 min.). J. OLIVER-GONZÁLEZ, University of Puerto Rico School of Medicine; P. M. BAUMAN, Army Medical Service Graduate School; and A. S. BENENSON, Tropical Research Medical Laboratory.

52. Chemotherapy in Schistosomiasis. (20 min.). H. MOST, New York University College of Medicine.

THURSDAY EVENING, NOVEMBER 4—6:00 P. M.
DINNER AND MEETING OF THE EDITORIAL COMMITTEE AND EDITORIAL BOARD,
THE JOURNAL OF PARASITOLOGY.

FRIDAY MORNING SESSION, NOVEMBER 5,—9:00 A. M.
CADET ROOM, PEABODY HOTEL
E. E. BYRD, UNIVERSITY OF GEORGIA, PRESIDING

Read

(Presentation of papers limited to ten minutes)

53. The place of dogs and ticks in the epizootiology of tularemia in Arkansas. (10 min.) (Standard lantern). E. L. CALHOUN, C. O. MOHR, AND H. I. ALFORD, U.S.P.H.S., Newton, Georgia.

54. Ground-Squirrel parasitizing ticks of Africa. (8 min.) (Standard lantern). H. HOOGSTRAAL, U. S. Naval Medical Research Unit #3, Cairo, Egypt.

55. Tick spermatozoa and their possible confusion with internal parasites of ticks. (10 min.) (Standard and 2 by 2 lanterns). G. ANASTOS, University of Maryland.

56. Life cycle and feeding habits of *Myobia musculi.* (10 min.) (2 by 2 lantern). G. H. WHARTON, University of Maryland.

57. Studies on the life history of oribatoid mites (ACARINA, ORIBATEI). (10 min.) (Opaque projector). H. G. SENGBUSCH, State University College for Teachers, Buffalo, New York.

58. Paper chromatography in mosquito taxonomy. (10 min.) (Standard lantern). D. W. MICKS, University of Texas Medical Branch.

59. Competitive breeding of two species of *Culex* in the laboratory. (10 min.). G. H. BALL, University of California at Los Angeles.

60. The effects of free-choice ingestion of phenothiazine by cattle on the incidence of the grub, *Hypoderma lineatum.* (10 min.). B. SCHWARTZ, D. A. PORTER, AND H. HERLICH, U.S.D.A.

Read by Title

61. Studies on the Lone Star Tick. III. Results of additional plot tests of potential acaricides (tickicides). G. W. HUNTER, III, F. M. PHILIPS, A. P. MOON, M. G. RADKE, J. S. WILLIAMS, D. H. SHAMER, AND G. M. PADILLA, Fourth Army Area Medical Laboratory.

62. An apparatus for the artificial feeding of fleas. L. KARTMAN, San Francisco Field Station, U.S.P.H.S.

Presidential Address, BALL ROOM, PEABODY HOTEL, 11:00 A. M.

63. There's Always Something New Under the "Parasitological" Sun. (50 min.). (Kodachromes). CORNELIUS B. PHILIP, Rocky Mountain Laboratory, Hamilton, Montana. Introduction by G. W. WHARTON, University of Maryland.

FRIDAY NOON, NOVEMBER 5, 12:10 P. M., SKYWAY, PEABODY HOTEL.

ANNUAL LUNCHEON AND BUSINESS MEETING OF THE SOCIETY.

C. B. PHILIP, PRESIDING

(get tickets at time of registration)

FRIDAY AFTERNOON SESSION, NOVEMBER 5, 3:00 P. M., INSTITUTE OF PATHOLOGY, UNIVERSITY OF TENNESSEE, SCHOOL OF MEDICINE.

By Demonstration

64. The pathology of the kidney of the chicken produced by cecal coccidiosis. E. M. BERTKE AND C. A. HERRICK, University of Wisconsin.

65. Flotation—a new method for the purification of water and the removal of *Endamoeba histolytica*. S. H. HOPPER, Indiana University School of Medicine; AND M. C. MCCOWEN, The Lily Research Laboratories.

66. Phase contrast microscopy of trichomonads. W. C. MARQUARDT, University of Illinois.

67. The chromosomes of the four species of human malaria. G. B. WOLCOTT, U.S.P.H.S., Columbia, South Carolina.

68. On the larval stages of *Taenia crassiceps* (Zeder, 1800), *Taenia tenicullis* Rudolphi, 1819, and *Paruterina candelabraria* (Goeze, 1782). R. S. FREEMAN, Ontario Research Foundation, Toronto, Canada.

69. Two indigenous cases of hydatid cysts from the human liver. P. A. FINCK, M.D. AND A. V. HUNNINEN, University of Tennessee.

70. Morphological changes in *Litomosoides carinii* at the third and fourth molts. J. A. SCOTT AND E. M. MACDONALD, University of Texas Medical Branch.

71. A new distribution record of *Dirofilaria tenuis* Chandler, 1942, and the discovery of the male. A. MCINTOSH, U.S.D.A.

72. Use of a standard planetary-type mixing machine for separating eggs of the swine whipworm, *Trichuris suis*, from feces. C. H. HILL AND R. E. ZIMMERMAN, U.S.D.A.

73. The possible relation of malignant esophageal tumors and *Spirocerca lupi* lesions in the dog. H. R. SEIBOLD, W. S. BAILEY, B. F. HOERLEIN, E. M. JORDAN, AND C. W. SCHWABE, Alabama Polytechnic Institute.

74. Filarial parasites in mammals. D. L. PRICE, Army Medical Graduate School. (also read—see No. 15).

75. The development of a species of *Opistholebes* in the final host, the affinities of some amphistomatous trematodes from marine fishes, and the allocreadioid problem. R. M. CABLE, Purdue University. (also read—see No. 98).

76. Monogenetic trematodes of some Gulf of Mexico fishes. W. J. HARGIS, JR., Florida State University. (also read—see No. 99).

77. A diplostomulum (TREMATODA: STRIGEIDA) in a tumor-like cyst on the brain of the stickleback, *Eucalia inconstans*. G. L. HOFFMAN, University of North Dakota.

78. A new trematode from the Lesser Panda, *Ailurus fulgens*. E. W. PRICE, U.S.D.A. (also read—see No. 100).

79. Experimental definitive hosts for *Fibricola cratera* (Barker and Noll, 1915) Dubois, 1932 (TREMATODA: DIPLOSTOMATIDAE). M. J. ULMER, Iowa State College.

80. Mucoid secretion by schistosome cercariae. F. J. KRUIDENIER, University of Illinois; AND M. A. STIREWALT, Naval Medical Research Institute.

81. Fluke-borne rickettsialike salmon poisoning of canines. C. B. PHILIP, Rocky Mountain Laboratory, Hamilton, Montana.

SATURDAY MORNING SESSION, NOVEMBER 6, 9:00 A. M., CADET ROOM, PEABODY HOTEL. C. A. HERRICK, University of Wisconsin, Presiding.

Read

(Presentation of papers limited to ten minutes)

82. Sexual anomalies in the male *Schistosoma japonicum* (Formosan strain). (10 min.) (Standard lantern). D. V. MOORE, New York University College of Medicine.

83. Studies on schistosomiasis japonica in Japan: Experiments on the control of *Oncomelania nosophora*. (10 min.). S. SUGIURA, Yamanashi Medical Research Institute, Kofu, Japan.

84. Results of laboratory screening tests of compounds for possible schistosomacidal agents. I. Rhodanines and Hydantoins. (10 min.) (Standard lantern). G. W. LUTTERMOSER AND H. W. BOND, National Institutes of Health.

85. Results of laboratory screening tests of compounds for possible schistosomacidal agents. II. N-(9' xanthenyl) carbamates. (10 min.) (Standard lantern). H. W. BOND AND G. W. LUTTERMOSER, National Institutes of Health.

86. Studies on schistosomiasis. XI. Some ointments examined for protection against *S. mansoni* cercariae in preliminary screening tests. (10 min.) (Standard lantern). H. A. KEMP, G. W. HUNTER, III, O. P. WILKINS, H. SMALLEY, AND M. A. DASHIELL, Baylor University Medical School and Fourth Army Area Medical Laboratory.

87. Effectiveness of Abbott's Insect Repellent Cream (E-4856) as a protective barrier against *Schistosoma mansoni* in mice. (10 min.) (Standard lantern). P. M. BAUMAN AND D. B. MCMULLEN, Army Medical Service Graduate School; and L. B. DURAN, Tropical Research Medical Laboratory.

88. A physiographic correlation of freshwater habitats and the distribution of *Australorbis glabratus* in Puerto Rico. (10 min.) (Standard and 2 by 2 lanterns). H. W. HARRY AND B. G. CUMBIE, Tropical Research Medical Laboratory. (Introduced by D. B. MCMULLEN).

89. Host-parasite relationships between *Australorbis glabratus* and the trematodes infecting it in Puerto Rico, with special reference to *Schistosoma mansoni*. (10 min.) (Standard and 2 by 2 lanterns). H. W. HARRY AND B. G. CUMBIE, Tropical Research Medical Laboratory. (Introduced by D. B. MCMULLEN).

90. Effect of snail maintenance temperatures on development of *Schistosoma mansoni*. (10 min.) (Standard lantern). M. A. STIREWALT, Naval Medical Research Institute.

91. Survival and weight loss of *Australorbis glabratus* from Pernambuco, Brazil, when kept out of water at various relative humidities. (10 min.) (Standard lantern). L. OLIVIER, National Institutes of Health; AND F. S. BARBOSA, Instituto Aggeu Magalhaes, Recife, Brazil.

92. The *in vitro* activity of schistosome cercariae and miracidia in serum from experimental, natural, and immunized hosts. (10 min.) (Standard and 2 by 2 lanterns). I. G. KAGAN, University of Pennsylvania.

93. The *in vitro* activity of cercariae of *Schistosoma mansoni* in serum of normal and immunized animals. (10 min.) (Standard and 2 by 2 lanterns). D. M. Levine and I. G. Kagan, University of Pennsylvania.

94. Longevity of *Schistosomatium douthitti* miracidia. (10 min.). J. H. Oliver, Jr. and R. B. Short, Florida State University.

95. Gametogenesis in *Schistosomatium douthitti* (Cort.). (10 min.) (Standard lantern). M. M. Nez, Florida State University. (Introduced by R. B. Short)

96. Observations on schistosome dermatitis in interior Alaska. (10 min.) (Standard and 2 by 2 lanterns). R. Harkema, North Carolina State College.

97. The life cycles of *Alaria arisaemoides* Augustine & Uribe, 1927, and *Alaria canis* La Rue & Fallis, 1936 (Trematoda: Diplostomidae), parasites of the Red Fox, *Vulpes fulva* (Desmarest). (10 min.) (Standard lantern). J. C. Pearson, Ontario Research Foundation. (Introduced by R. S. Freeman).

Saturday Afternoon Session, November 6, 2:00 P. M., Cadet Room, Peabody Hotel. A. C. Walton, Knox College, Presiding.

Read

(Presentation of papers limited to ten minutes)

98. The development of a species of *Opistholebes* in the final host, the affinities of some amphistomatous trematodes from marine fishes, and the Allocreadioid problem. (10 min.) (2 by 2 lantern). R. M. Cable, Purdue University. (also presented by demonstration—see No. 75).

99. Monogenetic trematodes of some Gulf of Mexico fishes. (10 min.) (Standard and 2 by 2 lanterns). W. J. Hargis, Jr., Florida State University. (also presented by demonstration—see No. 76).

100. A new trematode from the Lesser Panda, *Ailurus fulgens*. (5 min). E. W. Price, U.S.D.A. (also presented by demonstration—see No. 78).

101. Homoplastic and heteroplastic transplantation of gorgoderine trematodes. (10 min.) (Standard lantern). C. G. Goodchild, Emory University.

102. Biology and distribution of *Opisthorchis viverrini* in Thailand. (10 min.) (2 by 2 lantern). E. H. Sadun, U.S.P.H.S., Atlanta, Georgia.

103. The epidemiology of *Opisthorchis viverrini* in Thailand. (5 min.) (2 by 2 lantern). E. H. Sadun, U.S.P.H.S., Atlanta, Georgia.

104. Antigenic potency of cell-free extracts of Leptospires. (10 min.) (Standard lantern). M. D. Schneider, Third Army Area Medical Laboratory.

105. Host-virus-mosquito relations of Shope's fibromas in cottontail rabbits. (10 min.) (Standard lantern). L. Kilham and H. T. Dalmat, National Institutes of Health.

106. The challenge of helminthic parasitism in veterinary chemotherapy. (10 min.) (Standard lantern). A. O. Foster, U.S.D.A.

107. Studies on the biology of *Taenia crassiceps* (Zeder, 1800) Rudolphi, 1810. R. S. Freeman, Ontario Research Foundation.

108. New Species in the genus *Corallobothrium* Fritsch, 1886. (10 min.) (2 by 2 lantern). A. W. Jones and C. Kerley, University of Tennessee; and K. R. Sneed, University of Oklahoma.

109. An anatomical explanation of "apolysis" in the cestode *Multiceps packi* Christenson, 1929. (10 min.) (Standard lantern). E. E. Byrd, University of Georgia.

110. Attempts at *in vitro* cultivation of the fowl cestode, *Raillietina cesticillus.* (10 min.) C. F. Smith, Swift & Co., Research Laboratories.

To be Read if Time Permits

110a. A difference in the susceptibility of male and female hamsters to infection with the rat nematode, *Nippostrongylus muris.* (10 min.) (Standard lantern). A. J. Haley, The Johns Hopkins University.

Read by Title

111. Acquired immunologic resistance against *Schistosoma japonicum.* S. Lin, L. S. Ritchie, and G. W. Hunter, III, 406th Medical General Laboratory, APO 500.

112. Studies on schistosomiasis. VIII. Failure of copper oleate to protect mice against the penetration of the skin by cercariae of *Schistosoma mansoni.* A. P. Moon and G. W. Hunter, III, Fourth Army Area Medical Laboratory.

113. Persistence of egg-laying by *Oncomelania nosophora* females following isolation from males. Y. Otori, C. S. Sandiford and L. S. Ritchie, 406th Medical General Laboratory, APO 500.

114. Schistosome dermatitis in a South Florida lake. W. H. Leigh, University of Miami.

115. Host-parasite glycogen relationships in *Haematoloechus medioplexus.* T. D. Bair, Albany Medical College.

116. The life histories of *Phyllodistomum lohrenzi* Loewen, 1935, and *P. caudatum* Steelman, 1938 (Trematoda: Gorgoderinae). E. R. Beilfuss, Macalester College.

117. Acquired immunity in mice infected with *Postharmostomum helicis* (Trematoda: Brachylaematidae). H. Van Dyke, Carleton College.

118. Variation in size of *Postharmostomum helicis* (Trematoda: Brachylaematidae) in different rodent hosts. H. Van Dyke, Carleton College.

119. Notes on the life history of *Fibricola texensis* Chandler, 1942, in Florida. W. H. Leigh, University of Miami.

120. Parasites of Amphibia. Trematoda. A. C. Walton, Knox College.

121. Human cysticercosis in the United States. M. Campagna, Louisiana State Board of Health; C. Swartzwelder, Louisiana State University School of Medicine; and E. O. Comer, Veterans Administration Hospital, New Orleans.

122. Renal coccidiosis of Canada geese. Marion M. Farr. U.S.D.A.

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ABSTRACTS

1. Anatrichosoma cynamolgi, *a new Trichurid Nematode from Monkeys.* WILLARD N. SMITH, University of Maryland; and M. B. CHITWOOD, Animal Disease and Parasite Research Branch, A.R.S., U.S.D.A., Beltsville, Maryland.

Several specimens of a new nematode of the family Trichuridae were found by the senior author in the nasal septa of a number of *Cynamolgus philippinensis* examined from a colony at the National Institute of Health, Bethesda, Maryland.

This nematode, for which the name *Anatrichosoma cynamolgi* is proposed, does not fit into existing subfamilies of the Trichuridae and for it the writers propose a new subfamily, Anatrichosominae. Studies have revealed a close affinity to *Trichosomoides;* however, the male does not inhabit the uterus of the female and is slightly longer than the female.

Female: 17.8–19.33 mm. long. Head bearing cuticular inflation. Cuticle longitudinally striated with two broad lateral bands of punctations. Body sharply constricted on one side, at base of stichocytes Esophagus typical of superfamily; esophago-intestinal valve in enlarged anterior part of intestine. Intestine a long, simple tube emptying into large pre-rectum; anus terminal. Vulva located posterior to constriction at base of stichocytes; lips prominent but without appendage. Uterus long, broad, tightly packed with eggs. Oviduct long and coiled; ovary broad and straight followed by short narrow rachis. Eggs bioperculate, embryonated.

Male: 19.1–20.7 mm. long, 0.09 mm. wide. Cuticle thin; cephalic inflation absent. Esophagus one-third to one-fourth body length. Reproductive system typically trichuroid; spicule and cirrus absent. Tail bluntly rounded bearing two large subventral papillae and at least two pairs of lateral papillae.

2. *The Development of* Ornithofilaria fallisensis *Anderson, 1954 in* Simulium venustum *Say.* ROY C. ANDERSON, Department of Parasitology, Ontario Research Foundation, Toronto, Canada.

White Pekin ducks exposed in Algonquin Park, Ontario, during the spring and early summer, frequently become infected with *Ornithofilaria fallisensis* Anderson, 1954. Preliminary studies, using several species of mosquitoes, indicated that mosquitoes are not involved in the transmission of this worm. Seven ducks, exposed from the end of May to the middle of July, 1953, became positive for microfilaria 48–59 days after the first day of exposure. Birds exposed earlier or later remained negative. These data suggested that the birds became infected soon after exposure and this in turn suggested a common vector active in Algonquin Park during the latter parts of May, all of June and the first two weeks in July. One species of black fly, *Simulium venustum* Say, fulfills these requirements. Accordingly, studies were undertaken to see whether *Mf. fallisensis* would develop in this fly. It has been found that the microfilariae, when ingested by *S. venustum,* make their way to the body cavity where they develop to the third stage. This development has been studied in experimental flies kept at outdoor temperatures. In one experiment, third stage larvae appeared in the head 15 days after the flies had fed. In later experiments, during which the mean outdoor temperature was higher, larvae first appeared in the head as early as the 9th day. Numerous third stage larvae were injected subcutaneously into an uninfected duckling. Microfilariae were detected in the blood of this bird 30 days later.

3. *Fluctuations in intensity of* Amidostomum *infection in a wintering population of Canada geese.* CARLTON M. HERMAN, Patuxent Research Refuge, U. S. Fish and Wildlife Service, and EVERETT E. WEHR, Animal Disease and Parasite Research Branch, U. S. Agricultural Research Service.

It has been reported that Canada geese (*Branta canadensis*) may become infected with gizzard worms, *Amidostomum,* during their first few weeks of life and that these worms are of common occurrence in this species throughout its range.

Studies at Pea Island National Wildlife Refuge, North Carolina, were begun in 1949–50 and birds have been examined post mortem from this area each subsequent year. During the winter 1949–50, and again in 1951–52, goose droppings were examined by flotation technique. During the latter season fecal samples were collected, coincident with banding operations, from individual geese and quantitative studies on occurrence of *Amidostomum* eggs were made by modified Lane technique. Concurrently, geese were maintained in captivity and egg counts were made bi-weekly from November to March on samples from individual birds.

Autopsy findings revealed a high incidence of infection in Canada geese wintering at Pea Island during each of the seasons studied. Fecal samples from individual birds collected and examined during 1951–52 provide further evidence that most of the birds were infected.

The ratio of male to female gizzard worms in individual geese varied considerably, although

on an average males and females occurred in about equal numbers. It would appear, then, that the egg count technique as a criterion of total infection is not reliable. Several birds, maintained in captivity on wire-bottomed pens, showed evidence that the infection maintains its intensity with little or no apparent reduction of worm burden for a period of several months, although the egg counts may vary 100 fold or more from week to week. Such variation was noted in several geese retrapped in the wild at different time intervals. These fluctuations, therefore, make it impossible to employ tabulation of egg output in feces to trace course of intensity of infection in individual birds or to determine whether reinfection occurs on the winter range.

4. *The Pathogenic Effect on Lambs of a Bovine Strain of the Stomach Hairworm,* Trichostrongylus axei. J. H. Turner and K. C. Kates, Animal Disease and Parasite Research Branch, A.R.S., U.S.D.A.

Recently Gibson (1951, State Vet. J., Gr. Brit., Sept. 25, 6 pp.; 1952, J. Helminthol. **26**: 43–53; 1954, J. Comp. Path. & Therap. **64**: 127–140), working in England, reported that an ovine strain of *T. axei,* which had been isolated from a mixed infection of sheep nematodes by a single passage through an equine host, was very pathogenic when heavy infections were experimentally established in lambs. The writers experimentally established in lambs a strain of *T. axei* of bovine origin, which was determined to be at least equally pathogenic in the ovine host as the strain employed by Gibson. Each of 6 lambs was given a single dose of *T. axei* larvae, which varied from 50,000 to 500,000 larvae in individual lambs. Five of the 6 lambs died or were killed *in extremis* 5 to 6 weeks later. The main effects of the infections on the lambs prior to death were acute diarrhea, anorexia, and progressive emaciation. The infected lambs, 5 to 6 weeks after larvae were given, weighed 13 to 29 lbs. less than comparable uninfected controls. Hemoglobin levels and packed red cell volume (hematocrit) increased significantly in 5 of the infected lambs, a result of dehydration from the diarrhea and reduced fluid intake. All infected lambs at autopsy showed evidence of severe gastritis, variable duodenitis, and some hyperemia and edema of the abomasum and duodenum. The numbers of worms recovered from the infected lambs varied inversely with the numbers of larvae given.

5. *Age of Chickens and the Rate of Maturation of* Ascaridia galli. K. B. Kerr, Research Division, Dr. Salsbury's Laboratories, Charles City, Iowa.

In 1931, Ackert (Parasitology **23**: 360) showed that approximately fifty days were required following infection for *Ascaridia galli* to develop to sexual maturity and to produce eggs. Consistent field reports from broiler chicken operations have indicated approximately mature worms in birds only four weeks old, which is not consistent with the statement made by Ackert. The purpose of this work has been to determine whether age influences the rate of worm maturation.

The results may be summarized briefly by stating that the worms developed to sexual maturity in 30 to 35 days in chickens infected when less than 3 months of age. Approximately 50 days were required for full growth of the worm when the bird was 3 months old or older. It was proven that worms removed from birds less than 3 months old were fully mature by culturing eggs found in these worms and successfully infecting other chickens with them.

6. *Immunodiagnosis of* Trichinella spiralis *in Hogs by the Use of the Flocculation Test* Lois Norman and Elvio H. Sadun; Communicable Disease Center, Public Health Service, U. S. Department of Health, Education, and Welfare, Atlanta, Georgia.

Four experiments were conducted to determine whether infections with *Trichinella spiralis* in hogs can be detected by the flocculation test at the time the animals are slaughtered at the abattoirs. Eighteen hogs were reared and infected under controlled experimental conditions, and 42 were reared under natural conditions. All sera were tested by the bentonite flocculation test. The sera of some animals were also tested with a second antigen made by absorbing the acid soluble fraction of Melcher's purified antigen onto bentonite.

The flocculation test was quite reliable in detecting heavy infections of *T. spiralis* in swine if the serum was obtained a few weeks after ingestion of infected meat. On the contrary, when the infection was light or when the serum was obtained before the second week from ingestion of larvae the reaction failed to reveal the presence of infection. When infections were somewhat heavier all animals that had become positive reverted to a negative serology after several weeks. For these reasons the practicability of employing the flocculation test for the routine diagnosis of infected hogs at the time they are slaughtered at the abattoirs is very definitely limited.

7. *Factors in Racial Immunity of the White Rat to Cotton Rat Filarial Worms.* Leroy J. Olsen, J. Allen Scott, and Etta Mae MacDonald, The University of Texas Medical Branch at Galveston.

Previous studies have shown that in the white rat *Litomosoides carinii*, the filarial worm of the cotton rat, does not develop as well as in the normal host. A smaller proportion of the infecting dose starts to develop; such worms grow more slowly and die at an earlier age. In the present experiments cotton rats and white rats were infected subcutaneously under parallel conditions. After periods varying from 7 to 26 days some cotton rats were killed and their worms transferred in equal numbers to the abdominal cavity of white rats and cotton rats. At periods up to 35 days after the original infection, the animals were killed. On the average equal numbers of worms of the same average length were recovered from the experimental cotton rats and white rats. These worms were proportional in number and equal in length to those from the control cotton rats, i.e., those which had retained the original infection without transfer. From the control white rats not more than a few stunted worms were recovered. Evidently the white rat either inhibits the early stages of development or fails to stimulate the initiation of growth, but after this early part of development has been passed, the white rat provides an environment as good as that provided by the cotton rat. (This investigation was supported by research grant E64 C-5 from the National Microbiological Institute of the National Institutes of Health, Public Health Service.)

8. *A Statistical Analysis of the Growth in Length of the Filarial Worms in the Cotton Rat.* Mary G. Westbrook and J. Allen Scott, The University of Texas Medical Branch at Galveston.

A useful criterion of racial or acquired immunity to infection with *Litomosoides carinii* is the depressed growth rate of worms of a superimposed infection as compared to those of a primary infection. A study of the growth curves of these worms was made as a basis for comparisons which might reveal critical periods of differential growth. Measurements of nearly 1600 worms of various ages from primary infections in cotton rats were available for statistical analysis. Growth curves have been plotted and a study made of the various factors involved in the observed variability about these curves. Besides the random variability in length there was statistically significant variability between worms from the same rat and also between the mean lengths of worms of different rats treated alike. Some of this variability was found to be due to the age and sex of the rats. In addition to a number of important theoretical implications, the practical conclusions are that in experiments with this species all rats should be of the same age and sex. (This investigation was supported in part by research grant E64 C-5 from the National Microbiological Institute of the National Institutes of Health, Public Health Service.)

9. *Improved yields in axenic fluid cultures of* Neoaplectana glaseri (*Nematoda*). Norman R. Stoll, The Rockefeller Institute for Medical Research, New York.

This parasite goes through successive life cycles in favorable *in vitro* culture environments, and thus permits comparison of the latter in terms of the numbers of organisms developed. Under standard test conditions of 9 ml. beef heart infusion broth supplemented with 1 ml. of raw liver extract (RLE), in 22 by 180 mm. tubes, shaken in a temperature-controlled dark room for 3 weeks, the author has reported characteristic yields of 2500 to 5000 *N. glaseri* following an inoculation with 25 3rd-stage larvae (J. Parasitol. **39**: 422, 1953). By choosing as a source of RLE, livers from rabbits late in pregnancy and early post partum, average yields have exceeded 10,000 worms in the "standard" cultures. By using RLE of less potency (such as that from livers of non-pregnant does), yields have reached similar high levels by changing slightly the physical conditions. This can be produced by a shift from 10 ml. fluid in the regular tubes, to 30 ml. in 50 ml. Erlenmeyer flasks, keeping other standard factors (percentage supplement of RLE, inoculum of 25 worms, etc.) constant.

10. *The cultivation of the Free-living Stages of* Nippostrongylus muris *and* Necator americanus *in the Absence of Living Bacteria.* Paul P. Weinstein, Laboratory of Tropical Diseases, Microbiological Institute of the National Institutes of Health, Public Health Service, Bethesda, Maryland.

Nematode egg concentrates were successfully sterilized in hypochlorite solution and were cultured in various sterile media to which penicillin and streptomycin were added. For *Nippostrongylus muris* an average of 67% of the larvae reached the filariform stage in 50% chick embryo extract (CEE), with diminishing numbers developing as the concentration decreased;

at 12.5% CEE development was 0.5%. No filariform larvae appeared on heat-killed *Escherichia coli*, but a few (9.5%) developed on *E. coli* killed in formaldehyde. Less than 1% reached the filariform stage on Selas-filtered CEE, but when this filtrate was supplemented with heat-killed *E. coli*, 41% developed, and when supplemented with formaldehyde-killed *E. coli*, 88% developed to the filariform stage. This last combination resulted in the largest and most vigorous larvae. Filariform larvae from chick embryo extract cultures when injected into rats gave rise to normal adults.

In a single experiment, *Necator americanus* larvae developed to the filariform stage (67% yield) in 50% CEE; these were normal morphologically, but small in size. When this extract (untreated) was supplemented with formaldehyde-killed *E. coli*, 98% developed to the filariform stage and were normal in size. 50% CEE when diluted with beef heart infusion broth (1 part CEE: 2 parts broth) resulted in a higher yield of filariform larvae than CEE alone, and even when diluted 1:8, a yield of 59% filariform larvae was obtained. Broth alone, however, would not support any growth.

11. *Chemical Evidence of an Excretory Function for the so-called Excretory System of the Filariform Larva of* Nippostrongylus muris. Paul P. Weinstein and W. T. Haskins, Laboratory of Tropical Diseases, Microbiological Institute of the National Institutes of Health, Public Health Service, Bethesda, Maryland.

Precipitates were formed at the excretory pore of filariform larvae of *Nippostrongylus muris* incubated in dilute aqueous solutions of certain specific substances. Only mono-, di-, and tri-hydroxy benzenoid compounds capable of forming quinoid structures upon atmospheric or auto-oxidation gave these precipitates. With highly reactive compounds such as catechol, long plume-like precipitates or large globular masses were gradually produced by living larvae. The behavior of the precipitates toward solvents indicates that they are polymeric substances. These precipitates were accelerated in formation and increased in size when the quinoids were dissolved in tap water as compared with distilled water. The addition of calcium chloride (2 to 16 ppm.) to distilled water solutions of a reactive compound produced the same enhancement.

A theoretical consideration of the possible excretory substances produced by the larvae to account for the formation of the precipitate with quinoid compounds suggested that amines might be the substances involved. Heavy suspensions of larvae were treated with antibiotics to reduce bacterial contamination to an insignificant level. The larvae were washed free of the antibiotics and incubated in sterile distilled water or saline. Qualitative organic analyses of the residue from evaporation of the distilled water incubates demonstrated the presence of primary aliphatic amines to the exclusion of secondary and tertiary aliphatic amines and aromatic amines. The other major constituents consisted of 1,2-dicarboxylic acids and ammonium salts. To identify the amines, saline incubates were processed in an appropriate manner and subjected to paper partition chromatography. Ethylene diamine, cadaverine, ethanolamine, methyl amine, propyl amine, and butyl amine were identified. The isomeric form of the propyl and butyl amines was not determined.

12. *Nematocidal Screening Tests of Cadmium Compounds against Horse Strongyle Larvae.* Norman D. Levine and Virginia Ivens, University of Illinois.

Screening tests for anthelmintic activity were carried out by mixing the compounds with fresh horse feces containing eggs of several species of strongyles (Nematoda: Strongyloidea). The treated samples were allowed to incubate for a week at room temperature, and then examined for strongyle larvae by the Baermann technic. Cadmium chloride killed or prevented the development of larvae at a concentration of 0.0005 M. (0.009%). Cadmium bromide, cadimum nitrate and cadmium acetate did so at a concentration of 0.001 M. (0.034%, 0.031% and 0.027%, respectively). Cadmium oxide did so at 0.0025 M. (0.032%). Cadmium sulfate and cadmium anthranilate did so at 0.01 M. (0.208% and 0.39%, respectively). Cadmium carbonate and cadmium sulfide were inactive at 0.01 M. (0.172% and 0.145%, respectively).

13. *The Rate of Consumption of a 10 to 1 Salt-Phenothiazine Mixture Used in the Control of Parasites of Cattle.* Roy L. Mayhew, Louisiana State University.

An experiment in which a salt-phenothiazine mixture (10–1) was offered free choice to cattle has been conducted at Louisiana State University during approximately the past 5 years. Controls were maintained at all times to which salt only was offered. During almost 3 years the animals were isolated in individual pastures. One experiment in which 3% molasses was added to the salt-phenothiazine mixture was carried out for 4 months. Four to 7 animals were maintained at a time, usually there were 7. Most of the animals were from 5 to 9 months old

when placed on the experiment and for the most part were kept until a year's record was obtained. One group in which the experiment was interrupted at 3 different intervals was kept 2 years and 4 months.

The results of these experiments indicate that cattle eat varying amounts of the mixture at different times and that different animals eat different amounts of the mixture at the same time. There was no correlation between the amount consumed and the seasons of the year. The group to which molasses was added did not consume the mixture any more consistently than the others. The consumption of salt varied in the same manner as that of the salt-phenothiazine mixture. Much of the time many of the animals did not consume the minimum amount of phenothiazine necessary to control hookworms, nodular worms, and large stomach worms.

14. *The Effect of Various Minerals on the Growth of* Haemonchus contortus *Larvae.* R. F. SHUMARD, North Dakota Agricultural College, and C. A. HERRICK, The University of Wisconsin.

The effect of various minerals on the growth of the larvae of *Haemonchus contortus* was observed. Fecal material from lambs receiving iodized salt, cobaltized salt, salt containing, manganese, and trace mineralized salt (Co, Mn, Fe, Cu) was used as culture medium. The length of the third stage infective larvae was used as an assay. The length of the larvae varied significantly according to the nutrition of the lamb in which the parents of the larvae resided; whereas the variation in culture media had little effect on the difference in length of the larvae. Larvae from eggs produced by parents residing in lambs on cobalt or trace mineralized salt were of a significantly greater length than larvae from eggs produced by parents residing in lambs receiving manganese or iodized salt.

15. *Filarial Parasites in Mammals.* DONALD L. PRICE, Army Medical Service Graduate School.

In an attempt to find a filarial parasite that closely parallels species found in man, several hundred small mammals have been examined. Most of these were trapped in the Washington-Baltimore area. Out of 15 species examined 7 were found to harbor microfilariae. The hosts included *Procyon lotor, Didelphis virginiana, Mephitis mephitis, Mustela frenata, Mustela vison, Sciurus carolinensis,* and *Sylvilagus floridanus.* Eight species of adult filarial worms have been recovered from five species of mammals. Incidence has been found to be variable by locality. (also presented by demonstration—see No. 74).

16. *Diagnosis of* Physaloptera *in Dogs by Stool Examination.* F. A. EHRENFORD, Pitman-Moore Company, New Augusta, Indiana.

In canine fecal surveys for parasite incidence, *Physaloptera* receives little attention, and data provided by infrequent autopsies gives rise to sporadic reports of its occurrence. However, evidence follows to show that this gastro-intestinal, spirurid parasite is relatively common in midwestern dogs.

Autopsies of dogs has indicated an incidence of 30.1% in 186 dogs during 1952–53, Ehrenford (1953, J. Parasit. **39** Suppl: 34). Additional data on 345 dogs during 1953–54 gave an incidence of 22.3%.

Fecal examinations with sodium dichromate solution of sp. gr. 1.36 revealed certain ova, which appeared in small numbers, either alone, or in conjunction with the other frequently observed metazoan ova. Examination of ova *ex utero,* in saline from female *Physaloptera* established the fact that the ova observed in flotations were from adult *Physaloptera.* Schell (1952, J. Parasit. **38**: 462–472) has observed ova from *P. hispida* in cotton rats by use of salt flotation technique.

In a series of 31 tests on known infected dogs fecal flotation solutions and sedimentation smears were compared qualitatively and quantitatively. Resulting data showed that sodium dichromate, sodium nitrate, and sugar solutions yielded *Physaloptera* ova in a diagnosable condition. Sodium dichromate gave the best results in numbers and condition of ova; sodium nitrate was less efficient; sugar gave results similar to sodium nitrate; sedimentation gave the poorest quantitative results. Flotation solutions were 2–7 times better than the sedimentation method.

Physaloptera ova had the following characteristics in sodium dichromate flotation: 44 by 34 microns (average); ellipsoidal; embryonated; hyaline, refractile appearance; embryo faintly outlined.

17. *Internal Parasitism in Monozygotic Cattle Twins.* James R. Douglas, University of California at Davis.

In a series of uniformity trials Hancock (New Zealand Jour. Sci. 1950, 1951, 1952) demonstrated that in many characteristics, such as milk and butterfat production, grazing time, body temperature and respiration rate, monozygotic cattle twins are remarkably uniform. It was calculated for example, that one pair of monozygotic twins would replace, without loss of statistical efficiency, 72 pairs of randomly selected cattle in studies on grazing time. Hancock also found that monozygotic twins tended to maintain similar worm burdens (as measured by fecal egg counts) although the efficiency value for this characteristic was not as high as some others.

In this study fecal egg counts were made at intervals over a period of 5 months on 9 pairs of monozygotic cattle twins. The twins were between 3 and 9 weeks of age at the beginning of the observation period. Analysis of these data indicated that fecal egg counts varied as much between the members of a pair of twins as they did between unrelated animals.

Monozygotic twins may exhibit a generally uniform susceptibility to nematode infection which varies from pair to pair as it does from individual to individual in unrelated animals. However, under natural conditions of infection it is difficult to visualize how the exposure of the members of a pair of monozygotic twins to infective larvae would be any different from the exposure of 2 unrelated animals. It is concluded, therefore, that the acquisition of infective nematode larvae from a pasture is essentially a random process governed by the individuality of the animal rather than by its genetic composition.

18. *Importance of the* Ascaridia galli *Egg Shell to the Infectivity of Its Larvae.* M. F. Hansen and D. S. Turner, Kansas State College.

Two experiments were conducted comparing the infectivity of *A. galli larvae* under the following conditions: (1) Fed *per os* (a) larvae within egg shells, the usual condition and manner of entering the host, (b) larvae within egg shells which prior to feeding had been softened by chemical means, (c) larvae mechanically hatched from eggs; and (2) Eggs in categories (a) and (b) and larvae in category (c) were injected into the lumen of that part of the duodenum proximal to the gizzard. All chicks received 100 ± 10 embryonated eggs or hatched larvae depending upon their experimental group. The number of worms recovered from the 6 groups of chicks 21 days subsequent to their receiving infective eggs or hatched larvae was a measure of the infectivity of the larvae under the specific experimental conditions.

The results revealed that the eggs with softened shells and the hatched larvae had a low infectivity when given *per os* to chicks. The average number of worms recovered was 1.4 and 0.5, respectively. The average number of worms recovered from chicks which had this type of eggs and larvae injected into the duodenum was 4.9 and 4.8, respectively. There was only a small difference between the average number of worms recovered from chicks receiving embryonated eggs (shells not softened) *per os* and by injection into the duodenum. The average number of worms recovered was 5.5 and 6.2, respectively.

More experiments are being conducted to elucidate the role of the crop, gizzard, and/or proventriculus in the natural resistance of fowls to ascarid infections.

19. *Observations on the Anthelmintic Action of Carbon Disulfide on the Fowl Ascarid,* Ascaridia galli *(Schrank).* S. E. Knapp and M. F. Hansen, Kansas State College.

Four experiments were conducted utilizing a total of 155 chickens. The chickens were fed 100 ± 10 embryonated eggs of *A. galli* one month prior to treatment with different levels of carbon disulfide. The compound was administered to them in gelatin capsules which were inserted into the esophagus and then forced into the crop.

The following results were obtained from experiments using chickens which had been fasted for 12 hours prior to receiving carbon disulfide. This fasting of the chickens did not result in the spontaneous elimination of ascarids. At the time of treatment the average weight of the chickens was 860 gm. A dose of 0.3 ml. per chicken removed 88% of the ascarids. These treated chickens showed an average loss in weight of 29.3 gm. as compared with infected but untreated controls. At a level of 0.6 ml. per chicken the carbon disulfide removed 100% of the roundworms. These chickens lost an average of 88.8 gm. in body weight and a mortality of 33 1/3% was recorded. A dose of 0.15 ml. per chicken proved to be 65% effective; however, the chickens showed no weight losses but rather an average weight increase of 46.2 gm.

The efficacy of carbon disulfide was considerably reduced when given to non-fasted fowls.

Numerous experiments were conducted studying the effects of carbon disulfide on adult *A. galli.* A typical experiment consisted of suspending a specimen of the roundworm inside a glass tube having a volume of 80 cc. The glass tube was so constructed that no liquid carbon

disulfide contacted the test ascarid. The movements of the roundworm were recorded by a kymograph before and after exposure to carbon disulfide. The results of these studies revealed that gaseous carbon disulfide was toxic to the roundworm and that it probably penetrated through the cuticle. A dose as small as 0.05 ml. was sufficient to kill the test parasite.

20. *The Antigenic Role of the Excretions and Secretions of* Trichinella spiralis *in the Production of Immunity in Mice.* CHARLES H. CAMPBELL, University of North Carolina.

The excretions and secretions of *Trichinella spiralis* were collected by incubating larvae at 37° C. in a nutrient fluid composed of ox serum ultrafiltrate and Simms' X6 solution. After the desired period of incubation, the larvae, still motile, were removed from the fluid and discarded, and the fluid containing the excretions and secretions (ES antigen) was stored at −10° C. until needed.

To determine if animals infected with *T. spiralis* produce antibodies in response to the excretions and secretions of the worms which they harbor, the sera of rabbits and mice given varying numbers of immunizing infections were tested for antibodies reacting with the ES antigen. Positive tests occurred in both the rabbit and mouse antisera, whereas no positive reactions were observed in sera from non-immunized animals.

Experiments were performed in mice to determine if injections of the ES antigen would stimulate the production of a protective immune response. Adult worm counts 7, 9, 11, and 13 days after a challenging infection with *T. spiralis* revealed that mice injected with the ES antigen lost their worms more rapidly than non-injected control mice. In addition, female worms recovered from injected mice 7 days after infection were smaller than those from control mice. Thirty days after a challenging infection injected mice harbored about one-half as many larvae as the controls. It is believed that the smaller numbers of larvae recovered from the injected mice were due to the stunting of the female worms and the earlier loss of adult worms occurring in those animals.

21. *Some Effects of Altered Oxygen Tensions on Certain Plant-Parasitic and Soil-Inhabiting Nematodes* in vitro. JULIUS FELDMESSER, Section of Nematology, Horticultural Crops Research Branch, Agricultural Research Service, United States Department of Agriculture, Sanford, Florida AND WILLIAM A. FEDER, Cornell-U.S.D.A. Ornamentals Research Laboratory, Farmingdale, New York.

Various effects due to altered oxygen tensions have been observed for the following plant-parasitic and soil-inhabiting nematodes: *Aphelenchoides olesistus, Rhabditis* sp., *Heterodera rostochiensis* larvae and *Meloidogyne* sp. larvae.

Increased oxygen tensions in aqueous solutions can be effected by the oxidation of sodium sulfite to sodium sulfate. Specimens intended for study under altered oxygen tensions were maintained in tap water in Carrel flasks sealed with rubber stoppers and paraffin. Only specimens exhibiting marked motility were used in these tests. Sodium sulfite solutions were introduced through the stoppers by means of hypodermic syringes. The resulting solutions ranged from 100 ppm. to 400 ppm. of sodium sulfite.

Increased oxygen tensions resulted in progressive reduction and eventual cessation of motility. The times required to effect this at an oxygen tension equivalent of 400 ppm. of sodium sulfite were 4 minutes for *Aphelenchoides,* 15 minutes for *Rhabditis* and *Meloidogyne* and 20 minutes for *Heterodera.* Resumption of motility always occurred within 2 minutes after aeration of the solution. In several cases, recovery occurred after 20 hour periods of immobilization.

In preliminary tests, nematodes were suspended in sulfite solution in spot plates under oil seals. In several instances, these seals were incomplete and the nematodes were observed to migrate toward the air-water interfaces.

The sulfites and sulfates were proven to be non-toxic, since it was observed that nematodes exposed to excesses of these radicals were unaffected whenever they were provided with sufficient oxygen.

22. *The Incidence and Prepatent Period of* Ancylostoma caninum *and* Toxocara canis *in Prenatally Infected Puppies.* L. M. YUTUC, University of the Philippines.

Eighty-one puppies belonging to 17 litters were used. Of this number, 62 (76.54%) harbored both nematodes, 15 (18.52%) with pure infection of *Toxocara canis* and 4 (4.94%) with *Ancylostoma caninum.* The prepatent period of *Ancylostoma caninum* ranged from 16 to 29 days with an average of 20.10 days. In *Toxocara canis* the range of prepatent period was 21 to 30 days with an average of 24.8 days. The fecal material was obtained *per rectum* by medicine dropper. Sanitary measures to preclude infection from other sources were closely

observed. The species of hookworm was determined by the examination of the worms expelled after treatment.

23. *An Investigation on the Seasonal Fluctuations of Ascariasis in a Region of High Endemicity.* Lyman P. Frick, Helen C. Russell, and Lawrence S. Ritchie, 406th Medical General Laboratory, APO 500.

Seasonal fluctuations of ascariasis among individuals residing in Mutsusawa, Yamanashi Prefecture, have been studied during a period of 16 months. The incidence and intensity of infection among children and adults were essentially parallel. Constant decreases from summer peaks resulted in lowest points of incidence and worm burdens in December. After this time there were regular increases up to the summer peaks. A transient decrease of intensity in the spring was not reflected in the curve of incidence. The peak worm burdens among children seemingly occurred somewhat later than the peak incidence in that group. The differences between highest and lowest points of the curves were statistically significant. More intense parasitization in a significantly higher proportion of children was observed. This investigation offers support to the hypotheses proposed by other workers that ascariasis in Japan is largely dependent upon food habits on the one hand, and upon agricultural practices and climatic conditions on the other.

24. *The Incidence of Certain Helminth Parasites of the Cat.* Charles O. Baughn and Alexander Bliznick, Stamford Research Laboratories, American Cyanamid Co., Stamford, Connecticut.

Diagnosis of the common intestinal helminths of 126 cats received at this laboratory was accomplished by the simple smear, zinc sulfate flotation techniques and necropsy findings. The cats were obtained from rural upper New York State between November, 1952 and December, 1953. Cats were of mixed breeds and both sexes with average weight of 4½ lbs. (range 2–11 lbs.).

A total of 76.2% of the cats harbored intestinal helminths. The incidence of ascarids (*Toxocara cati*) was 62.7%; hookworm (*Ancylostoma caninum*) 36.5%; and tapeworm 15.1% (*Taenia* sp. 11.1%, *Dipylidium* sp. 1.6% and both species 2.4%).

In addition, the cat lungworms *Aelurostrongylus abstrusus* and *Capillaria aerophila* each occurred in 15.1% of the animals. At sacrifice 2.4% of the cats were found to harbor *Physaloptera rara.*

Of the 126 cats examined, infections with only ascarids occurred in 34.1%, only hookworm in 7.9%, only tapeworm in 0.8%. Double infections with ascarids and hookworm occurred in 17.4%, hookworm and tapeworm in 3.1%, and ascarids and tapeworm in 3.1%. Triple infections with ascarids, hookworm and tapeworm occurred in 7.9%.

The average number of intestinal helminths recovered from cats infected with each species was: 10.3 ascarids (range 1–108), 5.6 hookworms (range 1–28), 3.5 tapeworms (range 1–51) and 2.6 *Physaloptera* (range 2–3).

25. *Parasites of the Amphibia.* A. C. Walton, Knox College.

NEMATODA:— 1. *Aneides ferreus* (U.S.A.)—*Oxyuris dubia.* 2. *Aneides flavipunctatus* (U.S.A.)—*Oxyuris magnivulvaris.* 3. *Batrachoseps attenuatus* (U.S.A.)—*Oxyuris dubia.* 4. *Bufo marinus* (Mexico)—*Folleyella vellardi.* 5. *Bufo viridis* (Spain)—*Atractis waltoni.* 6. *Bufo* spp.? (Brazil)—*Cruzia tentaculata.* 7. *Ensatina escholtzii* (U.S.A.)—*Oxyuris dubia.* 8. *Ensatina escholtzii oreganus* (U.S.A.)—*Oxyuris dubia.* 9. *Hynobius naevius* (Japan)—2nd stage larvae of *Gnathostoma doloresi.* 10. *Hynobius stejnegeri* (Japan)—2nd stage larvae of *Gnathostoma doloresi.* 11. *Rana esculenta* (Europe)—*Angusticaecum numidicum.* 12. *Rana* sp.? (Guatemala)—*Folleyella brachyoptera.* 13. *Triturus granulosus* (U.S.A.)—*Cosmocercoides dukae* and *Hedruris siredonis.* 14. *Triturus torosus* (U.S.A.)—*Rhabdias* sp.? of Lehmann, 1954. 15. *Triturus vulgaris* (Europe)—*Capillaria fagei.* CESTODARIAN:— 1. *Triturus viridescens* (U.S.A.)—species not determined. CESTODA:— 1. *Bufo melanostictus* (Indo-China)—plerocercoids of *Diphyllobothrium erinacei.* 2. *Bufo melanostictus* (Java)—plerocercoids of *Diphyllobothrium erinacei.* 3. *Calyptocephalus gayi* (Chile)—*Ophiotaenia noei.* 4. *Rana cancroides* (Java)—plerocercoids of *Diphyllobothrium erinacei.* 5. *Rana limnocharis* (Indo-China)—plerocercoids of *Diphyllobothrium erinacei.* 6. *Rana septentrionalis* (U.S.A.)—*Cylindrotaenia americana.* 7. *Rana tigerina* (Indo-China)—plerocercoids of *Diphyllobothrium erinacei.* ACANTHOCEPHALA:— 1. *Bufo mauritanicus* (Morocco)—larval *Moniliformis moniliformis* 2. *Bufo melanostictus* (Formosa)—*Acanthocephalus sinensis.* 3. *Hyla aurea* (Australia)—encysted *Gordiorhynchus hylae.* 4. *Leptodactylus pentadactylus labyrinthicus* (Brazil)—larval *Centrorhynchus tumidulus.* 5. *Lymnodynastes dorsalis* (Australia)—encysted

Gordiorhynchus hylae. 6. *Rana cyanophlyctis* (India—larval *Pomphorhynchus dubius.* 7. *Rana temporaria ornativentris* (Japan)—larval *Porrorchis oti* from bladder. 8. *Rana tigerina* (India)—encysted *Centrorhynchus amphibius.*

26. *The Enteric Protozoa of Laboratory Golden Hamsters.* L. H. Saxe, State University of Iowa.

Eighteen golden hamsters (*Mesocricetus auratus*) from 8 sources have been examined for enteric Protozoa. The following organisms have been found: *Caviomonas mobilis, Enteromonas hominis, Monocercomonoides* sp., *Chilomastix bittencourti, Hexamitus muris, Giardia muris, G. lamblia, Hexamastix muris, Trichomonas muris, T. minuta, T. microti, T. wenyoni, Pentatrichomonas hominis,* and *Entamoeba muris. Caviomonas mobilis* has been known previously only from the guinea-pig (*Cavia porcellus*); the other organisms occur in the laboratory rat (*Rattus norvegicus*). Though hamsters have been infected experimentally with *Octomitus pulcher* from laboratory rats no natural infections have been found. Morphological studies and transfaunation experiments indicate that, in general, hamsters and rats harbor the same enteric Protozoa. Certain of these organisms may also occur in laboratory mice (*Mus musculus*) and other rodents.

27. *Protozoan Parasites of the Chinchilla in the Southeastern United States.* Frank A. Hayes and Ralph E. Thorson, Alabama Polytechnic Institute.

Genera of Protozoa that have been observed in chinchillas in the southeastern United States are *Giardia, Trichomonas, Chilomastix,* and *Balantidum.* With the exception of *Chilomastix* which has been observed only recently, all seem to cause varying degrees of diarrhea, intestinal pathology, and often death.

28. *Plasma Protein Variations in* Trypanosoma lewisi *Infected Rats and the Effect of Salicylate Treatment on these Variations.* W. M. Meyers and M. G. Lysenko, University of Wisconsin.

The present study was undertaken to confirm a previous preliminary report (Lysenko, 1951) that rats infected with *T. lewisi* and treated with sodium salicylate showed reduced amounts of gamma-globulin.

Electrophoretic determinations of the concentrations of plasma proteins were made on the following groups of rats at various intervals during the course of the infection: (A) *T. lewisi* infected animals, (B) *T. lewisi* infected animals treated with sodium salicylate daily (45 mg./100 g. body wt.), (C) uninfected animals receiving sodium salicylate (as in B), and (D) normal control animals. An increase in the concentration of gamma-globulin in (A) was observed whereas the animals in (B) showed a marked reduction in gamma-globulin. No significant variations in the concentration of gamma-globulin were observed in (C) when compared with the normal controls.

These findings indicate that the increased parasitemia in animals receiving salicylate may be due, at least in part, to the decreased antibody concentration. The lowered gamma-globulin levels (and total plasma proteins) may be due to an increased catabolism, suppression of antibody formation, or both. This is probably mediated via pituitary-adrenal interaction.

29. *The Metabolism of the Culture Form of* Trypanosoma gambiense. Theodor Von Brand, Eugene C. Weinbach, and Eleanor Johnson Tobie, Laboratory of Tropical Diseases, Microbiological Institute of the National Institutes of Health, Public Health Service, Bethesda, Maryland.

The culture form of *T. gambiense* corresponds essentially to the proventricular form developing in the tsetse fly. It consumes glucose, and its RQ is nearly 1.0. It produces large amounts of succinic and acetic acid and small amounts of pyruvic, lactic, C_1, C_3, C_4 and C_5 volatile acids. No oxalic, malic, citric, or fumaric acid accumulate in the cultures, nor is ethyl alcohol produced. The culture form is metabolically more versatile than the bloodstream trypanosome which degrades glucose nearly quantitatively to pyruvic acid and which consequently has an extremely low RQ.

30. *Observations on Toxoplasmosis in Dogs.* Leon Jacobs, Marjorie L. Melton, and M. Katherine Cool, Laboratory of Tropical Diseases, Microbiological Institute of the National Institutes of Health, Public Health Service, Bethesda, Maryland.

Dogs experimentally infected with *Toxoplasma gondii* were studied especially from the standpoint of their possible role in the epidemiology of toxoplasmosis. Only 4 of 19 dogs infected

with the virulent RH strain of *T. gondii* succumbed; these were all puppies 5 to 6½ weeks old. Of two 5-week-old litter mates inoculated intravenously with 10,000 and 100,000 parasites respectively, only the latter succumbed. One puppy 9½ weeks old remained asymptomatic following inoculation with 2 million parasites intravenously; a litter mate given 100,000 parasites at five weeks succumbed. Only one of 4 puppies infected with 10,000 parasites died; this dog was infected with 200 hookworm larvae on day 3.

Parasites were demonstrable only in puppies which succumbed or were sacrificed at 1 or 2 weeks. Brain, lung, liver, spleen, heart, kidney, and urine were found positive. Tissues from animals examined 2 months or longer after infection were not positive even by lengthy subinoculation procedures. A parasitemia was found in the 4 dogs which succumbed, and in 3 additional puppies, none older than 6½ weeks. In symptomless infections the parasitemia subsided after 10 to 14 days. Antibody response was rapid. Dye test titers of 1 : 16 or 1 : 64 were found at 1 week, 1 : 1024 or higher at 2 weeks. Persistence of high antibody levels varied considerably. Two dogs fed infected tissues showed transient antibody titers of 1 : 64 to 1 : 256.

Feces and urine taken from symptomless dogs at various times after infection, and fed to or injected into mice either fresh or after storage in soil or water, failed to produce toxoplasmosis in the rodents.

31. *Further Observations on the Growth of* Toxoplasma gondii *in Roller Tube Tissue Cultures.* Eli Chernin and Thomas H. Weller, Harvard University.

A preliminary communication (Proc. Soc, Exp. Biol. & Med. **85:** 68–72, 1954) reported the successful propagation of *Toxoplasma gondii* in roller cultures of mouse embryonic and several human tissues. *T. gondii* has since been grown in roller cultures of monkey testicular tissue and the observations on the behavior of the organism in mouse tissue cultures have been extended.

The RH strain of *T. gondii* was propagated through 23 serial passages in mouse cultures for a period of 138 days. During this time a relatively stable pattern of multiplication and resultant tissue cytopathology was manifest. It was found that the number of organisms produced in culture was profoundly affected by varying the intervals between changes of nutrient fluid. Routine fluid changes every 3–4 days resulted in peak yields as high as 2.7 million organisms per ml., while cultures in which fluids were not changed contained but one-fifth as many. Several mouse embryo culture passages were titrated both in mouse embryo roller tubes and in mice: the ID_{50} titer in the former ranged from $10^{-5.7}$ to $10^{-6.0}$ while the LD_{50} titer in mice varied from $10^{-4.4}$ to $10^{-6.4}$.

By means of coverslip cultures inserted in roller tubes and withdrawn at intervals after exposure to *T. gondii,* it was possible to study the early stages of cell invasion and the attendant multiplication of the parasite. Statistical data adduced from these observations lend support to the belief that the parasite muliplies by a process of binary fission.

32. *Variables Encountered during Studies on the Energy Metabolism of* Trichomonas vaginalis. C. P. Read and A. Rothman, University of California at Los Angeles, and The Johns Hopkins University.

Preliminary studies on the anaerobic energy metabolism of *T. vaginalis* (strains #2 and #5A) have shown that there are marked quantitative and qualitative changes in metabolism per cell during the cycle of population growth *in vitro.* These changes are complex functions of the age of the inoculum, the type of medium in which growth occurs, and the strain of *T. vaginalis* involved. Cells were harvested at different times after inoculation, thrice washed with Ringer's solution, and resuspended in Krebs-Ringer bicarbonate (pH 6) containing 0.01 M. glucose. The cells were incubated for 40 minutes under 95% N_2–5% CO_2 and manometric determinations made of rates of acid and metabolic gas formation. Controls for initial and final bicarbonate and appropriate retention corrections were used. Data are expressed as Q_{acid} and Q_{gas} (microliters/10^8 organisms/hour).

In C.P.L.M. medium both strains produce copious quantities of metabolic gas and acid. The quantitative patterns are quite different. Using a 24 hour inoculum strain #5A increases in Q_{gas} by more than 500%, the Q_{gas} at 6 to 8 hours being slightly over 1000. This is followed by a sharp decrease in Q_{gas} during the logarithmic phase of cell increase and a lessened rate of decrease in Q_{gas} during the phase of decreasing cell growth. Under the same conditions strain #2 has a higher initial Q_{gas} which increases somewhat during the initial half of the logarithmic phase of growth and decreases during the latter half of the logarithmic phase. With inocula of the same age, cells of strain #5A harvested from S.T.S. medium produce smaller quantities of metabolic gas during only a portion of the growth cycle while cells of strain #2 produce negligible quantities of metabolic gas. Data will be presented on changes in Q_{acid} and Q_{gas} after inoculation with 48 hour cells. The implications of these findings in extrapolating to *in vivo* metabolism will be discussed.

33. *Studies on the Amoeba-Bacteria Relationship in Amoebiasis. Comparative Results of the Intracecal Inoculation of Germ-Free, Monocontaminated, and Conventional Guinea Pigs with* Endamoeba histolytica. Bruce P. Phillips[1], Patricia A. Wolfe[2], Charles W. Rees[1], Helmut A. Gordon[2], Willard H. Wright[1], and James A. Reyniers[2]. [1]National Institutes of Health, National Microbiological Institute, Laboratory of Tropical Diseases, Bethesda, Md., and the [2]Lobund Institute, University of Notre Dame, South Bend, Indiana.

Germ-free monocontaminated, and conventional (control) guinea pigs were maintained on identical sterilized rations and inoculated intracecally with *Endamoeba histolytica* derived directly from microisolated cysts cultivated with *Trypanosoma cruzi*. From a large number of trials over a period of 2 years, technical difficulties were overcome to the extent that results are available on 35 germ-free animals so inoculated. None of the 35 guinea pigs developed amoebic lesions up to the maximum observation period of 33 days. Furthermore, the longest observed post-inoculation period of survival of the amoeba in the germ-free intestine was 5 days. Of 37 conventional guinea pigs inoculated as controls for the germ-free series, 34 developed acute ulcerative amoebiasis, and the other 3 animals harbored the amoeba when sacrificed at the 21st post-inoculation day. The *T. cruzi* failed to survive and there was no evidence that its presence in the cultures influenced the results in any way. The results of similar studies with monocontaminated animals were in great contrast to those obtained in the germ-free series. In 2 series of 5 and 7 animals each, acute ulcerative amoebiasis was produced in pre-experimental germ-free guinea pigs after oral administration of *Escherichia coli* and *Aerobacter aerogenes*, respectively, prior to intracecal injection of the amoeba. The comparative pathology of the disease in monocontaminated and conventional animals was studied in detail and is to be reported.

34. *Glucosamine in the Culture of* Endamoeba histolytica *with a Mixed Bacterial Flora.* J. Greenberg, D. J. Taylor, and H. W. Bond, Laboratory of Tropical Diseases, Microbiological Institute of the National Institutes of Health, Public Health Service, Bethesda, Maryland.

The aim of this investigation was to simplify the medium for growing *Endamoeba histolytica* with a mixed bacterial flora. A basal salt mixture of NaCl, KH_2PO_4, $CaCl_2$, $NaHCO_3$, and trace minerals including Mg, Mn, Fe, Cu, and Zn, was used throughout. All media were fortified with sterile rice powder. "Successful" media were those in which good growth of amoeba was maintained through 15 transfers, every other day for one month.

With commercial egg albumin added to the basal salt mix, amoebae survived only if one of a number of amines, amino alcohols (including glucosamine), or ammonium chloride were added to the cultures. Amino acids did not successfully fortify egg albumin nor did substrates with no nitrogen. Gelatin could substitute for egg albumin if glucosamine was also present; other organic amines, amino alcohols, and ammonium chloride could not substitute for glucosamine in the presence of gelatin. In cultures containing glucosamine, commercial peptones were able to replace proteins; a mixture of pure 1-amino acids approximating gelatin could not.

Under the conditions of the experiments in cultures of amoebae with mixed bacterial flora, glucosamine appears to be a specific requirement, direct or indirect, for the growth of amoebae.

35. *Comparative Effects of Oxygen upon Parasitic and Small Free-Living Amebae.* William Balamuth and Morgan Brent, University of California (Berkeley).

A technique has been devised to apply to cultures of amebae known gas mixtures under controlled rates of flow. A series of synxenic cultures containing a common flora has been developed; the amebae under study include, among others, *Entamoeba histolytica, E. coli, E. invadens, E. moshkovskii* (a sewage dweller), *Dientamoeba fragilis, Hartmannella rhysodes* and *Tetramitus rostratus*. The culture medium allows growth upon a solid surface; it is composed of 5% horse serum, 0.1% yeast extract, 0.1% glucose, 0.01% indigo carmine, 1.5% agar and buffered saline.

Experiments are being conducted in 2 kinds of vessels: elongated, flat-bottomed "boats" provided with gas inlet and outlet, and with a special port for introduction of redox electrodes; and specially incubated microscope slide-chambers. The gases are purified and mixed in our laboratory, to provide a range from complete anaerobiosis (0.01% oxygen) to maximally tolerated oxygen tensions; 2% carbon dioxide and varying concentrations of nitrogen are also included.

Experiments are in progress, and data are being collected in relation to minimal oxygen tensions permitting both survival and multiplication of the several species during 24- to 48-hour runs. Thus far the growth of *E. histolytica* has proved best in the "complete" absence of oxygen and has been definitely hampered at tensions even as low as 0.1%. On the contrary *E. invadens* and *E. moshkovskii* have multiplied in the range of 0–10% oxygen. *Dientamoeba* has reacted on the same order as *E. histolytica*. *Hartmannella* and *Tetramitus* have not multiplied in the absence of oxygen.

36. *The Effectiveness of the PVA-Fixative Technique in Revealing Intestinal Amebae in Diagnostic Cultures.* L. Norman and M. M. Brooke, Communicable Disease Center, Atlanta, Georgia.

Examinations of wet mounts and iron hematoxylin stained sediments preserved in PVA-fixative from 878 diagnostic fecal cultures were made, and the results compared. Of a total of 371 infections found by the 2 examinations 366 (or 94%) infections were identified in the stained films as compared to 212 (or 56%) identified in the wet mounts of the same cultures.

The increased number was due (a) to the addition of infections found only in the stained films and (b) to the identification of infections seen but not identified in the wet mounts. The numbers of infections of all 5 species of amebae were increased to varying degrees. The infections missed by the examination of the PVA-fixed material were almost always in the cultures growing so poorly that only rare organisms were seen in the wet mounts.

In order to reduce the work involved in the cultivation procedure, it is suggested that the preparation of stained smears be reserved for those cultures in which organisms are observed in wet mounts. In this study 94% of the infections would have been identified by this limited number of examinations of stained slides (250 slides rather than 878).

37. *Hyperactivity of Metachloridine on* Plasmodium gallinaceum *in Chicks Maintained on a Defined Diet.* D. J. Taylor and Joseph Greenberg, Laboratory of Tropical Diseases, Microbiological Institute of the National Institutes of Health, Public Health Service, Bethesda, Maryland.

The antimalarial activity of metachloridine and 6 other compounds was tested against the blood-induced form of *Plasmodium gallinaceum* in chicks maintained on (1) a defined diet (C-2) (Briggs *et al.,* 1952) and (2) Purena Startena (stock diet). Metachloridine and sulfadiazine were from 16 to 32 times more active against the infection in chicks fed the C-2 diet; while quinine, paludrine, atabrine, and terramycin were from 2 to 4 times more active in chicks fed the same diet. Chloroquine was equally as effective in both diets.

In an attempt to elucidate what factor or factors might be responsible for this enhancement of the activity of some of the compounds, metachloridine was selected as the test drug since (a) there were no metabolites known to be effective inhibitors of this compound and (b) the large difference in effectiveness in the 2 diets. A defined all-vegetable diet, adequate for the chick, containing chiefly corn, corn oil, and soy bean oil meal was first tested. The activity of metachloridine in the chicks fed this diet was no greater than in those chicks fed the stock diet. Further tests with corn or corn oil (up to 25%) as the single variant of the C-2 diet demonstrated that these products did not reverse the hyperactivity of metachloridine, while added soy bean meal in the C-2 diet contained an antagonistic factor. Various types of soy bean derivatives have now been tested; an "unknown" antagonistic factor has been demonstrated also in acid-washed soy bean grits and soy bean hulls.

The hyperactivity of metachloridine was not reversed when yeast, liver powder, P-aminobenzoic acid, alpha protein, sodium proteinate, or extra vitamins were incorporated individually in the C-2 diet.

38. *Studies on Glycogen Synthesis in White Rats infected with* Plasmodium berghei. Theodor von Brand and Teresa I. Mercado, Laboratory of Tropical Diseases, Microbiological Institute of the National Institutes of Health, Public Health Service, Bethesda, Maryland.

Previous studies had indicated that the glocogen synthesis in the livers of white rats infected with *Plasmodium berghei* was reduced as compared to uninfected animals upon feeding of glucose. In the present experiments series of normal and infected rats were fed nine different sugars and their liver glycogen quantitatively assayed; infected and uninfected rats starved for 24 hours furnished the base line for the calculation of the glycogen synthesis. Four hexoses, fructose, mannose, glucose, and galactose, served as glycogen formers; in all cases the glycogen synthesis was markedly lowered in the infected animals, the decrease in synthesis ranging from 38 to 91 percent. Three disaccharides, melezitose, lactose, and sucrose, gave essentially the same picture as the hexoses; the decrease in synthesis in the infected animals ranged from 31 to 56%. Two pentoses, xylose and arabinose, did not lead to any glycogen synthesis.

39. *Preparation and Agglutination of Merozoite Suspensions of the Chicken Coccidian,* Eimeria tenella. J. J. McDermott and L. A. Stauber, Rutgers University, State University of New Jersey.

The mechanism of immunity in coccidial infections has not been reinvestigated in many years. Attempts by various workers to demonstrate circulating antibodies in animals recovered from

an infection have shown inconclusive or negative results. New methods of approach to this problem, however, must be tested before the antibody basis can be rejected. Suspensions of the second generation merozoites of *Eimeria tenella* have been prepared to be used as test antigens for detecting agglutinins in the serum of sensitized animals. In general, the method of preparation has been to kill chickens on the fifth day after an infection, remove the ceca, wash out their contents with saline and lightly scrape and remove the cecal mucosa. This material is treated in a Waring blender and then subjected to a short period of tryptic digestion at room temperature. The resultant supernate is washed and resuspended a number of times in formalinized saline, and the concentrated suspension containing large numbers of merozoites with minimum extraneous material is preserved in formalinized saline and refrigerated.

Preliminary experiments have shown these merozoite suspensions to be antigenic in the rabbit and rooster. This was demonstrated by agglutination of the parasites with sera from these injected animals. Adsorption of these antisera with uninfected mucosal suspensions has not removed the agglutinating capacity. Agglutinins have been demonstrated for the first time in the sera of experimentally infected chickens. They may persist for at least 30 days after infection, with maximum serum titers reaching 1–320 between the 10th and 15th days postinfection.

40. *The Effects of Cecal Coccidiosis on the Ability of Chickens to do Muscular Work.* Laurence Levine and C. A. Herrick, University of Wisconsin.

The effect of cecal coccidiosis on the ability of Single Comb White Leghorn chickens to do muscular work was determined.

One of muscles of the gastrocnemius complex was used in the work tests. It was stimulated indirectly on one side of the animal and directly on the other and contracted against a previously calibrated spring in a lever system. The recorded height of contraction was converted to work in gr. cm. with the aid of calibration data.

The results of these experiments showed that the directly and indirectly stimulated gastrocnemii of infected chickens could do only 40% of the total work done by the controls. This reduction in work output on the part of infected animals is characterized by a pronounced and early fatigue and a decrease in the height of contraction. The indirectly stimulated gastrocnemii of infected chickens fatigued in one-third the time of the controls and could do at their maximum less work that that of the controls at the end of the test period. In a similar manner, the directly stimulated muscles of infected chickens reached a maximum of work output which was 69% that of the controls and fatigued in one-half the time.

41. *A Field Strain of* Eimeria tenella *Resistant to Sulfonamides.* E. Waletzky, R. Neal and I. Hable, Chemotherapy Department, Stamford Research Laboratories, American Cyanamid Co., Stamford, Connecticut.

A strain of *Eimeria tenella* from a Delaware broiler flock which failed to respond to conventional sulfaquinoxaline or sulfamethazine treatment for cecal coccidiosis was isolated by Dr. M. S. Cover from 3 affected birds. In repeated laboratory trials this strain has shown no response to drug-diets of 0.025 to 1.0% of sulfaquinoxaline, and is accordingly more than 40 times as resistant to this drug on a dosage basis as ordinary strains of *E. tenella*.. Surprisingly, increased resistance to other sulfonamides, which are also antagonized by *para*-amino-benzoic acid, is considerably less, e.g. about 5-fold to sulfamethazine. No increased resistance is present to a variety of other anticoccidial agents acting by other mechanisms, e.g. nitrophenide, nitrofurazone or arsenosobenzene. Studies on the life cycle, pathology and cross-immunity to a standard strain of *E. tenella* confirm the species diagnosis. The bearing of these results on the widespread use of chemoprophylaxis in poultry coccidiosis will be discussed.

42. *Efficacy of Furazolidone, a New Nitrofuran, against Blackhead and Coccidiosis.* Paul D. Harwood and Dorothy I. Stunz, Dr. Hess and Clark, Inc.

Furazolidine or N-(5-nitro-2-furfurylidene)-3-amino-2-oxazolidone was synthesized recently by the Eaton Laboratories of Norwich Pharmacal. Data furnished us by Norwich investigators showed that it was a bactericide of low toxicity for vertebrates. Tests against avian diseases seemed in order. Five poults, each 3 weeks of age, were infected experimentally with blackhead by administration of embryonated eggs of *Heterakis*, and placed in each of 5 cages. Four of the 5 control birds died of blackhead; 3 birds receiving 0.0055% furazolidone in the mash starting 2 days after infection; 1 from each pen receiving 0.011% furazolidone starting 2 and 9 days after infection, and 2 from the pen receiving 0.011 per cent furazolidone starting 16 days after infection, died. In a second test similar results were obtained. Research in this problem

has continued at several experiment stations. Thus far treatment of coccidiosis has been limited to infections with *Eimeria tenella*. At 0.011% of the feed, furazolidone controls deaths if given not later than 48 hours after infection; at 0.0055%, deaths are reduced about two-thirds; development of immunity in treated groups is not retarded. Toxicity is low. The LD_{50} for chickens is about 500 mg. per kilo. Chicks and poults receiving from 0.0011% to 0.02% furazolidone in the feed show an increased growth rate that is most pronounced under conditions of poor sanitation. At 0.033% of the mash chicks show a slight growth retardation that first becomes statistically significant after 4 weeks of continuous medication.

43. *Cytochemistry of the Macrogametocyte and Unsporulated Oocyst of* Emeria brunetti *and* E. acervulina. Walter H. Pattillo and Elery R. Becker, Iowa State College.

This report is an excerpt from a study of the cytochemistry of the stages in the life cycle of *Eimeria brunetti* and *E. acervulina*. The "indifferent stages," viz., very young rounded schizonts, macrogametocytes and microgametocytes, did react negatively in the periodic acid-Schiff (PAS) test for polysaccharides. Increasing amounts of polysaccharide were observed throughout the cytoplasm of the macrogametocyte from the young growing form to the walled oocyst. Appropriate control tests confirmed that the polysaccharide was glycogen. The plastic granules also reacted positively in PAS. Saliva or diastase removed glycogen, but reactivity of plastic granules persisted. These components arose at the periphery as minute points on the inside of the limiting membrane that grew until a maximum of 1.73 microns was attained. After acetylation, they lost their colorability in PAS, but recovered it with subsequent exposure to KOH. They colored intensely when submitted to the mercuric bromphenol blue test for protein. Peptic digestion reduced the intensity of this reaction, but did not completely eliminate it, and the PAS reaction continued positive. Tests of the granules for lipids were negative. The reactions of the granules thus suggest that they contain a concentration of mucoprotein. Other well-known reactions are stainability in eosin, but refractoriness to borax carmine and Delafield's hematoxylin.

The fate of the granules is transformation into plaques which fuse on the surface into the oocyst wall. Plaques and wall continue to exhibit the cytochemical reactions of the plastic granules, except that the resistance to pepsin digestion is practically complete.

44. *Results of Placing Single Trichomonads* (T. gallinae) *in the Mouths of Pigeons.* R. M. Stabler and Joanne Tsuneko Kihara, Colorado College, Colorado Springs.

Ten *Trichomonas*-free common pigeons (*Columba livia*) were each given a single organism of the highly virulent Jones' Barn strain of *T. gallinae*. Five remained uninfected; 5 became positive. All of the infected birds died of trichomoniasis, at 13, 8, 12, 14, and 12 da. (11.8 da. av.). One hundred and nineteen controls, receiving 5–10,000 Jones' Barn *T. gallinae*, died on an average of 8.2 da. following infection. The 5 pigeons not becoming infected with single-*Trichomonas* implantations were then given 5–10,000 Jones' Barn *T. gallinae*. All became infected, and all died of trichomoniasis, 3 at 6, 1 at 7, and 1 at 13 da. (7.6 da. av.).

45. *Evaluation of the Susceptibility of* Trichomonas vaginalis *Infections to Systemic Medication.* Clyde Swartzwelder, James G. Mulé, William W. Frye and Frances Vella, Louisiana State University, School of Medicine, New Orleans, Louisiana.

Carpenter reported the symptomatic and parasitologic cure of 11 patients with vaginal trichomoniasis who were *treated systemically* with chloroquine diphosphate (Med. Times **80**: 129, March, 1952). Systemic treatment of vaginal trichomoniasis would offer important advantages over topical therapy. Therefore, the following study was initiated to determine whether or not vaginal trichomoniasis can be treated successfully with chloroquine or other drugs with protozoacidal properties when taken orally. The selection of some of the drugs was influenced by activity against *Trichomonas vaginalis* either *in vitro* or when applied to the vagina. The following drugs and dosages were employed in series of 8 to 17 patients each: (1) chloroquine diphosphate, 2.5 gm. over a 3 day period; (2) chloroquine diphosphate, 0.5 gm. daily for 18 days; amodiaquin hydrochloride, 0.6 gm. in a single dose; primaquine diphosphate, 25.6 mg. daily for 14 days; (5) quinacrine dihydrochloride, 2.8 gm. over a period of 7 days; (6) pyrimethamine, 150 mg. over a 4 day period; (7) diiodohydroxyquinoline, 650 mg. 3 times a day for 20 days. None of the above compounds, when taken orally, had a lasting therapeutic effect on *T. vaginalis* infections. The flagellates were demonstrable in 18 of 19 patients after treatment with chloroquine. The report that chloroquine taken orally produced a high rate of parasitologic cure of vaginal trichomoniasis was not confirmed by this study.

45a. *The Severity of Cecal Coccidiosis Infection in Chickens as Related to the Age of the Host and the Number of Oocysts Ingested.* JOHN L. GARDINER, Animal Disease and Parasite Research Branch, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland.

Three separate hatches of chicks were carried through a series of experiments covering a period of 7 weeks for each hatch. At weekly intervals a random selection of chicks from each hatch was divided into 4 groups, 3 of which were inoculated with 50,000, 100,000, and 200,000 sporulated *Eimeria tenella* oocysts respectively, the fourth group being kept as an uninoculated control.

In every series of experiments it was found that chicks inoculated at 4 weeks of age were more seriously affected by the coccidial organisms than were any other age group between 1 and 6 weeks. Chicks 2 weeks of age were in every series the least seriously affected of any age group.

The larger inoculations affected chicks up to 3 weeks of age to a greater degree than did the smaller inoculations. With chicks 4 weeks of age and older, the effect on the severity of the disease of the number of oocysts administered was of less relative importance.

45b. *Blackhead of Turkeys Primarily Transmitted through Cecal Worm Eggs.* EVERETT E. WEHR, Animal Disease and Parasite Rsearch Branch, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland.

That the causative agent of blackhead, a protozoan parasite known as *Histomonas meleagridis*, is transmitted through the eggs of the cecal worm of poultry, *Heterakis gallinae*, and that other means of transmission probably are relatively unimportant, are conclusions drawn from investigations carried out during the year. Tests showed that the causative protozoans were capable of surviving only a short time in poultry feces, unless they were localized in cecal worm eggs, which apparently serve as intermediate or transfer hosts. A large number of susceptible turkey poults fed massive doses of these protozoans from culture or those taken direct from infected ceca, failed to develop symptoms of blackhead. That the organisms in question were infective and capable of producing the disease was shown by the fact that comparable birds inoculated rectally with small numbers of the organisms, obtained from similar sources, readily became infected, developed symptoms of the disease, and died in large numbers. When susceptible, parasite-free, turkeys were fed feces containing cecal worm eggs deposited on soil 7 months earlier by birds harboring the causative protozoans, they developed the disease and a large proportion of them died from its effects. At autopsy these birds harbored large numbers of cecal worms which, apparently, had developed from the eggs they had ingested. The available evidence indicates, therefore, that the control of blackhead is largely a matter of preventing the acquisition of cecal worms. The acquisition of blackhead by turkeys as a result of ingesting the causative organisms with the droppings of affected birds, in the absence of cecal worm eggs, does not appear to enter very prominently into the transmission of this disease.

46. *Parasites of the Amphibia. Protozoa.* A. C. WALTON, Knox College.

The following hosts and/or protozoan parasites have been added to the catalog since earlier publication: 1. Adult Amphibia (U.S.A.)—Cairns (1953) reports that *Balantidium helenae, Chilomastix cauleryi C.* sp.? of Alexieff, *Hexamitus* sp.? of Dujardin, *Karotomorpha bufonis, Monocercomonoides* sp.? of Travis, *Proteromonas longifila, Trepomonas* sp.? of Dujardin, *Trichomonas prowazeki, Trimitus parvus*, and *Urophagus intestinalis* develop best in adult hosts while *Endolimax ranarum, Hexamitus intestinalis, Octomastix batrachorum, Octomitus intestinalis, Tritrichomonas augusta*, and *T. batrachorum* are more common in anuran and urodele tadpoles. 2. *Ambystoma jeffersonianum* (U.S.A.)—*Isospora jeffersonianum.* 3. *A. maculatum* (U.S.A.)—*Chilomastix caulleryi, Hexamastix batrachorum, Hexamitus batrachorum, Octomitus* sp.? of Honigberg & Christian, 1952, and *Tritrichomonas batrachorum.* 4. *A. mexicanum* (Cent. Amer.)—*Tritrichomonas batrachorum.* 5. *A. tigrinum* (U.S.A.)—*Chilomastix caulleryi, Hexamitus batrachorum, H.* sp.? of Honigberg & Christian, 1952, *Octomitus* sp.? of H. & C., *Retortomonas* sp.? of H. & C., 1952, *Trepomonas* sp.? of H. & C., 1952, and *Tritrichomonas batrachorum.* 6. *Ambystoma* sp.? (Mexico)—*Tritrichomonas batrachorum.* 7. *Bufo boreas halophilus* (U.S.A.)—*Tritrichomonas batrachorum.* 8. *Bufo bufo* (Europe)—*Trichomonas prowazeki.* 9. *Bufo marinus* (Brazil)—*Tritrichomonas batrachorum.* 10. *Bufo paracnemis* (Brazil)—*Tritrichomonas batrachorum.* 11. *Bufo terrestris* (U.S.A.)—*Trichomonas prowazeki*, and *Tritrichomonas batrachorum.* 12. *Bufo* sp.? (Mexico)—*Tritrichomonas batrachorum.* 13. *Microhyla ornata* (Bombay, India)—*Protoopalina dharwarensis, P. indica, P. karnatakensis*, and *Zelleriella microhylae.* 14. *Philautus* sp? (Bombay, India)—*Cepedea philauti*, and *Zellericlla froilanoi.* 15. *Pleurodeles*

waltlii (Spain)—*Balantidium galianoi.* 16. *Rana arvalis* (Europe)—*Tritrichomonas batrachorum.* 17. *Rana boylii* (U.S.A.)—*Trichomonas prowazeki,* and *Tritrichomonas batrachorum.* 18. *Rana catesbiana* (U.S.A.)—*Hexamita* sp.? of Wenrich, 1946, and *Trichomonas prowazeki.* 19. *Rana cyanophylyctis* (Bombay, India)—*Cepedea dimidiata naglavensis.* 20. *Rana esculenta ridibunda perezi* (Portugal)—*Trichodina ranae.* 21. *Rana temporaria* (Europe)—*Trichomonas prowazeki.* 22. *Salamandra salamandra* (Europe)—*Tritrichomonas batrachorum.* 23. *Scaphiopus holbrookii* (U.S.A.)—*Tritrichomonas batrachorum.* 24. *Triturus torosus* (U.S.A.)—*Eimeria grobbeni,* and *Trypanosoma barbari.*

47. *Introduction to Schistosomiasis Symposium.* Donald B. McMullen, Army Medical Service Graduate School.

(no abstract submitted)

48. *Biology of the Schistosome Complexes.* Robert E. Kuntz, Naval Medical School, Bethesda, Maryland.

An accelerated and general interest in the schistosomiases during the past decade has resulted in an accumulation of information pertaining to the physiology, immunity, geographical relationships of the parasites to their intermediate and definitive hosts, new reservoir host problems and other phases of the biology of the schistosome parasites of man and animals. Experimental studies evaluating the susceptibility of both mammalian and molluscan hosts to infection by different schistosomes have revealed many fundamental facts regarding geographical variations expressed in terms of physiological as well as taxonomic relationships. Furthermore the maintenance of reasonably normal infections of the schistosomes of man in lower mammals, especially rodents, lead to speculation and a search for reservoir hosts for *S. mansoni* and *S. haematobium.* Although the role of reservoirs for *S. japonicum* has been recognized for years only recently have rodents been found naturally infected with *S. mansoni.* Infection of man by the schistosomes of domestic and wild animals in parts of Africa has been suspected for some time but the confusing relationship of animal to human schistosomes has not been satisfactorily explained and in some regions the parasite-snail association is not clear or is unknown. Problems of an allied nature occur in the Orient where *S. japonicum* is common in lower mammals but apparently is absent in man.

Schistosome dermatitis is a problem within itself since it is so widespread and may be caused by any of a long list of schistosome cercariae found in marine as well as in fresh waters.

Obviously we are no longer concerned with simple problems involving a few species of schistosomes. We are dealing with inter-related schistosome complexes which may vary with geographical location and under different biological circumstances.

49. *Natural History and Control of the Aquatic Snails that Transmit Schistosomes of Man.* Louis J. Olivier, National Institutes of Health.

(Invited paper, no abstract submitted)

50. *The Biology and Control of the Amphibious Snails that Serve as Intermediate Hosts for* Schistosoma japonicum. Lawrence S. Ritchie, 406th Medical General Laboratory.

(Invited paper, no abstract submitted)

51. *Immunological Aspects of* Schistosoma mansoni *Infections.* José Oliver-González, University of Puerto Rico School of Medicine; Preston M. Bauman, Army Medical Service Graduate School; and A. S. Benenson, U. S. Army Tropical Research Medical Laboratory.

Infection of the mammalian host with *S. mansoni* involves exposure to the cercaria and to the metacercarial stage for a short period of time (up to 40 to 50 days after penetration), then to the adult worm over the many years of its life span and finally to the large number of eggs trapped in the liver and intestinal tissue, and extending over the active life time of the female worms. These various stages reflect themselves in specific immunological responses.

The specificity of the antibodies can be demonstrated in the artificially immunized animal and in the human host. Immunization of experimental animals with specific stages results in stage-specific antibodies which can be shown when appropriate absorption techniques are used. Antibodies in the infected humans also show the same pattern of stage specificity.

Antibodies to adults and cercariae are demonstrable by the precipitin test using saline extracts of these forms as antigens. Anti-egg anti-bodies are demonstrable by the circumoval pre-

cipitin test and anticercarial antibodies are also demonstrated by cercarial agglutinations. Serum absorption demonstrates the specificity of each of these stages and also the fact that the egg absorbs not only the egg antibody but also the cercarial antibody.

In human infections, anti-cercarial antibodies are present in high titer during early schistosomiasis and the titer falls or becomes negative in long-standing infection. Anti-adult precipitins persist during the course of infection in a relatively low titer. Circumoval precipitins increase in titers as infection progresses, consistent with the accumulation of eggs in tissues.

Skin test reactions in human patients show variations in reponse during early and late infection, which are taken to correlate with the stage-specificity of the infection.

52. *Chemotherapy in Schistosomiasis.* Harry Most, New York University School of Medicine.

(Invited paper, no abstract submitted)

53. *The Place of Dogs and Ticks in the Epizootiology of Tularemia in Arkansas.* Ernest L. Calhoun, Carl O. Mohr, and Hugh I. Alford, Communicable Disease Center, Public Health Service, U. S. Department of Health, Education, and Welfare, Atlanta, Georgia.

The record of incidence of reported tularemia in Arkansas for the period 1945–1950 is 9.2 cases per 100,000 population and higher by more than twice that for any other state. Fifty-six percent of 704 cases studied by Washburn and Tuohy during 1938–1948 showed a history of tick bite. Only 31 percent showed a history of exposure to rabbits. In a study undertaken in Garland County in 1952, rabbit populations appeared to be low; during 205 miles driven during early evening visual surveys only 26 rabbits (0.1 per mile) were observed along roadsides. Small rodent populations also were low; mice of the genus *Microtus* were scarce. Other animals appeared responsible for part of the distribution of tularemia and infected ticks.

A survey for presence of tularemia agglutinins in dogs revealed that 33 percent of 136 hunting dogs were positive in titres of 1 : 20 to 1 : 2560. Infected lone star ticks (*Amblyomma americanum*) were taken from dogs. The average number of lone star ticks per dog was high; the annual average per infested dog was 8.8. Thirty-nine percent of the dogs were infested by this tick. About one tick in 2,400 was found with infection based on annual inoculation test. A smaller percentage of dogs bore American wood ticks, *Dermacentor variabilis.*

If not primarily responsible for the existence of tularemia infection among ticks, dogs (and probably other canids) at least disseminate infected ticks and thus have marked influence on the distribution of human cases. The great majority of cases are scattered ones contrasting sharply with the grouping of such rodent-parasite borne diseases as scrub typhus and murine typhus.

54. *Ground-Squirrel Parasitizing Ticks of Africa.* H. Hoogstraal, U.S. Naval Medical Research Unit #3, Cairo, Egypt.

The previously poorly known African ground-squirrel parasites, *H. calcarata* Neumann, 1902, and *H. houyi* Nuttall and Warburton, 1915, are redescribed to elucidate obvious differences between them and between a ubiquitous tick of superficially similar facies, *H. leachii.* The original description of the female of *H. calcarata* is actually that of *H. houyi.* These two species appear to be host-specific, *H. calcarata* on *Xerus rutilus* and *H. houyi* on *Euxerus erythropus. X. rutilus* ranges in East Africa through Somalia and those parts of Kenya and Ethiopia which lie east of the Rift Valley. *E. erythropus* ranges from the Atlantic coast of Central West Africa through the Anglo-Egyptian Sudan and Uganda to those parts of Ethiopia and Kenya which lie west of the Rift Valley. The inter-relations of ticks, hosts, physical barriers, and fauna districts of Africa are noted. In view of the significant potential of finding disease-causing organisms in these ticks and ground-squirrels, the inter-relations of these biological factors from an epidemiological viewpoint suggest further research. These apparently specific host-parasite relationships suggest the separate generic specificity of each host.

55. *Tick Spermatozoa and their Possible Confusion with Internal Parasites of Ticks.* George Anastos, University of Maryand.

The tick spermatozoa as they leave the male are apparently still in an immature condition as further development into flagellate forms has been observed within the female, correlated with the development of the eggs. The immature tick spermatozoa as seen in both the male and female and to a lesser extent the mature flagellate spermatozoa as seen in the female, differ considerably from the typical flagellate spermatozoa of other animals. These spermatozoa show an apparent similarity to some protozoan and helminthic parasites reported in ticks.

56. *Life Cycle and Feeding Habits of* Myobia musculi. G. W. Wharton, University of Maryland.

The eggs of *Myobia musculi* are attached to the hairs of the host. There are two larval stages and two nymphal stages in the life cycle. Males and females occur in about equal numbers, The adult females are the migratory forms and infection from one mouse to another is accomplished by them. Feeding is a continuous process. The food appears to be interstitial fluid.

57. *Studies on the Life History of Oribatoid Mites* (Acarina, Oribatei). H. G. Sengbusch, State University College for Teachers, Buffalo, N. Y.

Detailed knowledge of the development of larvae and nymphs of oribatoid mites is virtually non-existent. To supply some of this information the following subjects were investigated; first, the development of a technique whereby free-living mites can be reared in the laboratory; second, the size, shape, and length of time involved in the various stages of development of 3 species of oribatoid mites; and third, observations on the biology of oribatoid mites.

Adults were collected by means of a modified Tullgren apparatus. These mites were isolated by species in stender jars. Filter paper was placed on the floor of the jar and an attempt was made to keep it continually moist. These stenders were placed in Scheibler desiccator jars containing a saturated solution of $ZnSO_4$ in their bases to provide a relative humidity of 82%. To insure a constant temperature of 25° C., the desiccators were placed in an incubator. Eggs were isolated and placed in microcells modified from a description given by Jacot. *Protococcus* was used as food for the immature stages.

Three species of oribatoid mites were raised in sufficient numbers to make the results significant. *Galumna elimatus ithacensis* took from 72–107 days from oviposition to the emergence of the adult. *Galumna longipluma* required 58–66 days and *Galumna nervosus* required 45–50 days. Descriptions and figures of the immature stages of *G. nervosus* and *G. elimatus ithacensis* were made. An hypothesis on the life cycle of the galumnid mites in nature was stated.

58. *Paper Chromatography in Mosquito Taxonomy.* Don W. Micks, University of Texas Medical Branch.

Mosquitoes belonging to the *Culex pipiens* and *Anopheles maculipennis* complexes have been studied by paper chromatography. One and two-dimensional chromatograms of both whole mosquitoes and extracts revealed different patterns for American *Culex pipiens,* European *pipiens, fatigans* and *molestus.* This method was also applied to *Anopheles atroparvus, typicus, messeae* and *subalpinus* from Italy and a strain of *atroparvus* from England. The chromatographic patterns of these forms revealed certain quantitative differences in ninhydrin-positive materials.

59. *Competitive Breeding of Two Species of Culex in the Laboratory.* Gordon H. Ball, University of California at Los Angeles.

A colony of *Culex tarsalis* which had been reared successfully in the laboratory for several months following the method of Brennan and Harwood (1953) was supplemented in July 1953 by a collection of egg rafts, supposedly of *C. tarsalis,* taken in nature. Adults and larvae collected at the same time and from the same locality showed nothing but *C. tarsalis.* Representative samples of larvae hatching from these rafts and the adults into which they transformed were examined and only *C. tarsalis* was found. However, either one or more of the egg cases or else a few of the larvae or pupae were evidently of *C. quinquefasciatus,* since within 4 to 5 generations of laboratory breeding, including a period of one month of minimum care with considerable reduction in number of adult mosquitoes, *C. quinquefasciatus* had replaced *C. tarsalis* entirely. In this instance, interspecific competition had resulted in the complete elimination of a less successful species from a controlled environment within a short period of time, even though the eliminated species was capable of maintaining itself without difficulty under such conditions when not subjected to competition from the second species.

60. *The Effects of Free-Choice Ingestion of Phenothiazine by Cattle on the Incidence of the Grub,* Hypoderma lineatum. Benjamin Schwartz, Dale A. Porter, and Harry Herlich. Animal Disease & Parasite Research Branch, U. S. Department of Agriculture.

Free-choice ingestion by cattle of a mineral mixture medicated with phenothiazine apparently curtailed to a significant extent the appearance in the backs of these animals of the common ox-warble or grub, *Hypoderma lineatum.* The medicated mixture consisted of 3 parts each by weight of bonemeal, limestone, and salt, and 1 part phenothiazine. In 1 trial 2 bovines

on the medicated mixture had a total of 11 grubs throughout the season, whereas 2 comparable controls had 82 grubs. In another trial 6 principals had an average of 8 grubs per head throughout the season, 2 of them being entirely free of these parasites, whereas 6 controls averaged 36 per head. The difference of 28 grubs per head is statistically significant.

Should these data be sustained by further observations, selfmedication with phenothiazine, which already holds promise of being a valuable adjunct to the control of gastrointestinal nematodes of bovines, would have the added advantage of holding in check one of the most costly arthropods that parasitizes cattle. The control measure here discussed would be of value, moreover, even when used on an individual basis, whereas current methods of control must be carried out on a community basis to be of value. Furthermore, current control methods involve the use of rotenone to destroy grubs after they have injured the hides, whereas the phenothiazine prophylaxis here outlined would preclude this injury to the extent that grub development would be checked.

61. *Studies on the Lone Star Tick.* III. *Results of Additional Plot Tests of Potential Acaricides (Tickicides).* G. W. Hunter, III, F. M. Philips, A. P. Moon, M. G. Radke, J. S. Williams, D. H. Shamer, and G. M. Padilla, Fourth Army Area Medical Laboratory, Brooke Army Medical Center, Fort Sam Houston, Texas.

During 1952 Dieldrin, Aldrin, Lindane, DDT, and Chlordane were tested as acaricides on 0.025-acre plots at Camp Bullis, Texas, (Therrien, Hunter, Moon, and Adams, 1953, J. Parasit. (Suppl.) **39:** 26; 1954, J. Econ. Ent. **74:** 76–78). During 1953 Sulphenone, Neotran, N-butylacetanilide and Heptochlor, were checked at three dilutions each and Dieldrin and DDT were retested on 0.025-acre plots. Dieldrin (which was the best in 1952) still proved to be superior to the other compounds. When applied at the rate of 0.5 lb. per acre, Dieldrin gave 93% control in 24 hours, 98% in 48 hours, 99% in 1 week, 98% in two weeks, and 97% at the end of 4 weeks.

Quadrats were staked out in the area of greatest tick density in each plot and pretreatment counts were made on all plots. Following application of the dusts, counts were made at 24 hour, 48 hour, and then 7 and 14 day intervals for 6 weeks. Untreated control plots were checked at the same time. Abbott's formula (1925, J. Econ. Ent. **18:** 265) was used as a criterion of effectiveness.

62. *An Apparatus for the Artificial Feeding of Fleas.* Leo Kartman, Communicable Disease Center, U. S. Department of Health, Education & Welfare, Public Health Service, San Francisco Field Station, San Francisco 18, California.

An apparatus has been designed for the *in vitro* feeding of fleas. This apparatus is based essentially upon the principle of transferring controlled thermal gradients from a water bath to a metal dish containing blood upon which fleas are allowed to feed through an animal skin membrane which is in direct contact with the fluid. Successful feeding tests have been accomplished with the fleas, *Xenopsylla cheopis* and *Malareus telchinum.* Preliminary experiments also have demonstrated the feasibility of infecting fleas with plague organisms, *Pasteurella pestis,* by means of *in vitro* feeding techniques. The data indicated that the thickness of the skin membrane probably is a limiting factor in the ability of fleas to feed under artificial conditions. The effects of storage of blood and skins in a deep freeze (−50° C) and the age of blood and skins seemed to have little influence provided that a favorable skin membrane was used. It is suggested that such an apparatus may be employed in an experimental approach to basic problems of flea physiology, nutrition, and disease transmission.

63. *"There's Always Something New under the 'Parasitological' Sun."* Cornelius B. Philip, Rocky Mountain Laboratory, Hamilton, Montana. Presidential Address.

64. *The Pathology of the Kidney of the Chicken Produced by Cecal Coccidiosis.* E. M. Bertke and C. A. Herrick, University of Wisconsin.

The petechial hemorrhages which appeared in the kidney parenchyma of the infected chickens 24 hours after inoculation reached their maximum size by the end of the fourth day.

Tubular changes began early in the infection. The distal convoluted tubules were the first to be affected and appeared to be more severely damaged. Dilation of Bowman's capsules and an increase in the cellular components of the glomeruli also appeared at this time. These changes were followed by an increase of the intercellular material.

Changes in uric acid excretion were detected within 24 hours. By the fourth day uric acid excretion decreased to 64% and by the tenth day to 46% below normal. The rate of excretion increased gradually to approximately 90% by the third week after infection.

65. *Flotation—a New Method for the Purification of Water and the Removal of Cysts of* Endamoeba histolytica. S. H. Hopper, Indiana University School of Medicine; and Max C. McCowen, The Lilly Research Laboratories, Indianapolis, Indiana.

To purify surface water add 10 ppm. of a nontoxic quaternary ammonium compound and blow compressed air through the mixture at the rate of approximately 1½ liters per minute. Mud and bacteria rise to the top in the foam and can be scraped off. 1500 cysts of *Endamoeba histolytica* per ml. were completely removed. Examinations for cysts were made in the original inoculated sample before treatment, on the finished water after treatment, and on the foam blown off the top during the flotation. Controls were nontreated cysts. Aeration without addition of a quat neither kills nor removes the cysts. Bacterial reduction is approximately 99 percent and finished water is clear. Less than one ppm. of quat remains in the water. More than 95% of particles 259 millimicrons in size were removed. Finished water should be chlorinated in the usual manner.

(Process confirmed by independent research done at Harvard University under a contract with the Medical Research and Development Board, Office of the Surgeon General, Department of the Army.)

66. *Phase Contrast Microscopy of Trichomonads.* W. C. Marquardt, The University of Illinois.

(no abstract submitted)

67. *The Chromosomes of the Four Species of Human Malaria.* Gordon B. Wolcott, U. S. Public Health Service.

Observations on the nuclei of *Plasmodium vivax, P. ovale, P. malariae,* and *P. falciparum* were made on living asexual parasites using phase contrast microscopy. The nuclei are visible only in the late stages of the asexual cycle. In all 4 species the chromosome number is 2, with one chromosome about a micron in length and the other smaller. In the resting nuclei of late presegmenting stages and in merozoites there is no nuclear membrane and the chromosomes remain condensed. The centriole is occasionally visible.

68. *On the Larval Stages of* Taenia crassiceps (*Zeder, 1800*), Taenia tenuicollis *Rudolphi, 1819, and* Paruterina candelabraria (*Goeze, 1782*). Reino S. Freeman, Ontario Research Foundation, Ontario, Canada.

(no abstract submitted)

69. *Two Indigenous Cases of Hydatid Cysts from the Human Liver.* P. A. Finck, M.D., Department of Pathology, and A. V. Hunninen, Department of Preventive Medicine, University of Tennessee, Memphis, Tennessee.

(no abstract submitted)

70. *Morphological Changes in* Litomosoides carinii *at the Third and Fourth Molts.* J. Allen Scott and Etta Mae MacDonald, The University of Texas Medical Branch at Galveston.

The time of molting of the cotton rat filariids has been a useful criterion of the effect of racial and acquired immunity on the growth rate. Each morphological stage has a characteristic type of stoma. The stomata of the third, fourth, and adult stages will be demonstrated, as well as the transition from one type to another. (This investigation was supported by research grant E64 C-5 from the National Microbiological Institute of the National Institutes of Health, Public Health Service.)

71. *A New Distribution Record of* Dirofilaria tenuis *Chandler, 1942, and the Discovery of the Male.* Allen McIntosh, Animal Disease and Parasite Research Branch, A.R.S., U.S.D.A., Beltsville, Maryland.

In March, 1947 a correspondent from Sarasota, Florida forwarded to the then Zoological Division, Beltsville, Md., 2 live raccoons, *Procyon lotor,* with the statement that they were "infected with filarial worms, the microfilariae being about 6 times the size of those that occur in the cotton rat." The correspondent thought it might be of interest to establish the identity of these worms.

The raccoons were killed soon after being received, and were examined for parasites. Sev-

eral adult filarial worms of both sexes were recovered in the subcutaneous tissue. In size, the females were similar to the filariid described by Chandler from a raccoon from Texas, and a comparison of specimens with the type of *Dirofilaria tenuis,* indicated that the Florida raccoons harbored the same filarial species. The male not having been described, the following description is given: Similar to female but with length of 41 to 43 mm. and maximum diameter of 0.19 to 0.24 mm., which is approximately one-half that of female. Esophagus 0.47 mm. long by 0.22 mm. wide. Cloacal aperture 0.07 to 0.077 mm. from caudal extremity. Posterior portion of body spiralled in 3 to 4 loops. Genital papillae 9 or 10 to a side, irregularly arranged, some specimens having 5 preanals on one side and 4 on the other; a pair of adanals, medial to line of preanals; a pair of postanals, adjacent to cloaca and near median line; 3 pairs of postanals, on line with preanals. Long spicule 0.2 to 0.22 mm.; short spicule 0.09 to 0.13 mm.

72. *Use of a Standard Planetary-type Mixing Machine for Separating Eggs of the Swine Whipworm,* Trichuris suis, *from Feces.* Charles H. Hill and Ralph E. Zimmerman, Animal Disease and Parasite Research Branch, A.R.S., U.S.D.A., Beltsville, Maryland.

A new technique for screening the eggs of *Trichuris suis* from hog feces has been developed which is more efficient and less time consuming than other methods now in use. The method makes use of a standard, planetary type mixing machine, a specially made, four-bladed brass paddle, a cylindrical screen basket consisting of supporting rods and a bottom and wall of 200 mesh bronze screen wire, and a large round copper vessel fitted to the mixer stand in place of the regular container. To operate, the basket containing about 400 grams of feces is placed into the large vessel which is filled with water. The paddle revolves and at the same time rotates around the inside wall of the basket, in effect, keeping the screen wall unclogged. During the screening process, water is added to the large vessel by means of a small jet connected to a tap until about 2 gallons have passed through. This water is collected in a large glass jar. To finish the flushing and screening process, water under moderate pressure is then added to the inside of the basket by means of a small built-in copper pipe connected to the tap. After sedimentation in the large glass jar, the sediment containing eggs and very fine debris may be recovered. In tests, the method has removed more than 90% of *Trichuris* eggs from feces.

73. *The Possible Relation of Malignant Esophageal Tumors and* Spirocerca lupi *Lesions in the Dog.* H. R. Seibold, W. S. Bailey, B. F. Hoerlein, E. M. Jordan, and C. W. Schwabe, Alabama Polytechnic Institute.

(no abstract submitted)

74. *Filarial Parasites in Mammals.* Donald L. Price, Army Medical Service Graduate School. (also read—see No. 15).

75. *The Development of a Species of* Opistholebes *in the Final Host, the Affinities of Some Amphistomatous Trematodes from Marine Fishes, and the Allocreadioid Problem.* Raymond M. Cable, Purdue University. (also read—see No. 98).

76. *Monogenetic Trematodes of Some Gulf of Mexico Fishes.* W. J. Hargis, Jr., Florida State University. (also read—see No. 99).

77. *A Diplostomulum (Trematoda: Strigeida) in a Tumor-like Cyst on the Brain of the Stickleback,* Eucalia inconstans. Glenn L. Hoffman, University of North Dakota, Grand Forks.

Fifty-three of 64 (83%) sticklebacks from a small stream in Grand Forks were found infected with a new strigeid metacercaria which will be described later. These larvae were located within the ventricles, and in a cyst-like structure that had formed at the caudo-dorsal position of one or both optic lobes. These "cysts" were located in that position only, and there were far more diplostomula in the "cysts" than in the ventricles which indicates that the "cyst" is the definitive location of the mature metacercaria.

The cyst-like structure consists of an outpocketing of the dura that encloses one to many diplostomula that are surrounded by metaplastic tissue which appears to be epithelial in nature; movement of these metacercariae seems to be restricted to a very small space.

Life history studies are in progress and a more detailed dscription will be given in a later publication.

78. *A New Trematode from the Lesser Panda,* Ailurus fulgens. Emmett W. Price, U.S.D.A. (also read—see No. 100).

79. *Experimental Definitive Hosts for* Fibricola cratera (*Barker and Noll, 1915*) *Dubois 1932* (*Trematoda: Diplostomatidae*). MARTIN J. ULMER, Iowa State College.

Diplostomula from pelvic musculatures of naturally-infected *Rana pipiens* collected near Ames, Iowa were fed to laboratory-reared white rats and white mice. White mice, 70 days post-feeding contained many gravid adults in the duodenum. Only sexually immature worms, however, were recovered from the small intestine of white rats killed 43 and 70 days post-feeding. These results are in partial disagreement with published records listing both white rats and mice as suitable experimental hosts for the adult stage of this parasite.

Attachment of adult worms to the intestinal mucosa is tenacious, the forebody sometimes completely encircling a villus. Serial sections of adults *in situ* show that holdfast, oral sucker and acetabulum are all involved in attachment to the host tissue. Corroded host epithelium appearing within the oral sucker and in areas adjacent to the holdfast of attached worms, together with the presence of cellular debris in the intestinal ceca of the parasite suggests a dual mode of nutrition in this species.

80. *Mucoid Secretion by Schistosome Cercariae.* F. J. KRUIDENIER, The University of Illinois; and M. A. STIREWALT, Naval Medical Research Institute, Bethesda, Maryland.

Glands of the "penetration" complex of the cercaria of *Schistosoma mansoni* are now commonly differentiated into acidophilic and basophilic groups. A reported, positive chromic acid-Feulgen (Bauer) reaction for glycogen has been interpreted as a pseudo-reaction, possibly indicating presumptive mucin in certain of the glands (Axmann, 1947).

Strong red to red-violet reactions by cercarial tissues to the periodic acid-Feulgen technique of Hotchkiss indicate a widespread distribution of polysaccharide, mucopolysaccharide, glycoprotein or glycolipoid compounds in this cercaria. Certain glands of the "penetration" complex react especially strongly, staining an unmistakable purple to red-purple. Metachromasia of these glands is indifferent (toluidine blue) to border-line (thionin). Further tests indicate that the glands most probably contain mucopolysaccharide or glycoprotein secretions.

Hotchkiss-positive secretions can be differentiated in 3 pairs of these glands in young, intra-redial cercariae. These substances accumulate as the glands, and cercariae, develop. Evidence indicates a partial discharge of the secretions by the mature cercaria while still within the snail host. Further discharge occurs from the emerged, free-swimming cercaria but most of the secretions are retained through this phase. A more extensive use (and value) during and/or after penetration and during subsequent migrations in the definitive host appears most probable.

Similar pairs of glands are included in the "penetration" complex of the cercaria of *Schistosomatium douthitti.*

81. *Fluke-borne Rickettsialike Salmon Poisoning Disease of Canines.* CORNELIUS B. PHILIP, Rocky Mountain Laboratory, Hamilton, Montana.

(no abstract submitted)

82. *Sexual Anomalies in the Male* Schistosoma japonicum (*Formosan Strain*). DONALD V. MOORE, New York University College of Medicine.

Three male *Schistosoma japonicum* (Formosan strain) recovered from hamsters harboring bisexual infections were found to possess anomalies of the sex organs previously undescribed for this species. One male worm possessed a well developed ovary and oötype. The other two worms possessed supernumerary testes. In the one worm with 2 supernumerary testes the supernumerary sex organs were provided with a vas efferens and a seminal vesicle separate from the vas efferens and seminal vesicle of the normal testes. An examination of 400 male *S. japonicum* (Japanese and Chinese strains) from a variety of mammalian hosts harboring bisexual and unisexual infections revealed no abnormalities of the sex organs. (Accepted for publication by the *Journal of Parasitology*).

83. *Studies on Schistosmiasis Japonica in Japan.* S. SUGIURA, Yamanashi Medical Research Institute, Kofu, Japan.

(no abstract submitted)

84. *Results of Laboratory Screening Tests of Compounds for Possible Schistosomacidal Agents. I. Rhodanines and Hydantoins.* G. W. LUTTERMOSER AND H. W. BOND, Laboratory of Tropical Diseases, Microbiological Institute of the National Institutes of Health, Public Health Service, Bethesda, Maryland.

By use of the method of screening compounds for schistosomacidal activity described by Luttermoser (1954), it was found that 5-(3′,4′-dichlorobenzylidene)rhodanine (I) and

5-(p-chlorophenyl)-5-methylhydantoin (II) were active. The compounds were administered intraperitoneally to white mice infected with *Schistosoma mansoni*. Twenty-one more rhodanines, 19 more hydantoins, and 3 thiohydantoins were synthesized or obtained from without this Laboratory. All the rhodanines except two and all the hydantoins were compounds with substitutions in the 5 position. In addition to compounds I and II, 5,5-diphenylhydantoin (III); 5-(4′-hlorobenzylidene)rhodanine; and 5-(3′,4′-methylenedioxybenzylidene)rhodanine were schistosomacidal when the maximum tolerated dose was given intraperitoneally daily for 5 days in 10% gum acacia. The activity of compounds I and III approached that of Miracil D in white mice. None of the 36 compounds was active when administered orally as suspensions in gum acacia, likewise 8 were inactive as corn or sesame oil solutions when given orally or intraperitoneally. Preliminary tests of 3-(9′-xanthenyl)rhodanines and -hydantoins indicated 3-(9′-xanthenyl)rhodanine and 3-(9′-xanthenyl)-5,5-diphenylhydantoin to be as active as any of the above rhodanines and hydantoins.

Compounds I and III were administered to mice with encysted larvae of *Trichinella spiralis* and compound I was given to rats with *Cysticercus fasciolaris*. No effects on these parasites were observed.

85. *Results of Laboratory Screening Tests of Compounds for Possible Schistosomacidal Agents. II. N-(9′-Xanthenyl) Carbamates.* H. W. Bond and G. W. Luttermoser, Laboratory of Tropical Diseases, Microbiological Institute of the National Institutes of Health, Public Health Service, Bethesda, Maryland.

It had previously been observed in this Laboratory (Bond and Luttermoser, 1954, J. Am. Pharm. A. (Scient. Ed.) **43**: 32–35) that certain N-(9′-xanthenyl) amides showed activity against *Schistosoma mansoni* infections in Swiss albino mice. Included among the active compounds were the N-(9′-xanthenyl) derivatives of ethyl carbamate, *n*-propyl carbamate, and *n*-butyl carbamate.

In the present work, 15 additional N-(9′-xanthenyl) carbamates have been prepared and tested against *S. mansoni* infections in mice. About half of the new compounds showed some activity when administered intraperitoneally. A few approached, but none equaled, Miracil D in activity. None was active orally.

The unsubstituted carbamates used as starting materials in the synthesis of the N-(9′-xanthenyl) carbamates were also tested. Only one of these, the *n*-cotadecyl, showed any definite activity.

All of the carbamates described herein are quite insoluble in water , but many are somewhat soluble in corn, sesame, and similar edible oils. Unfortunately, however, no activity was observed when representative carbamates were administered orally or intraperitonally as solutions in such oils. Miracil D base was active both orally and intraperitoneally when administered as a solution in sesame oil.

86. *Studies on Schistosomiasis.* XI. *Some Ointments Examined for Protection Against* S. mansoni *Cercariae in Preliminary Screening Tests.* Hardy A. Kemp, G. W. Hunter, III, Orin P. Wilkins, Harry Smalley, Mary Ann Dashiell, Baylor University Medical School, Houston, Texas, and Fourth Army Area Medical Laboratory, Brooke Army Medical Center, Fort Sam Houston, Texas.

When it was found that copper oleate failed to protect white mice for 30 minutes against the cercariae of *Schistosoma mansoni* a program was developed to test a number of compounds. Nineteen commercial ointments designed for use in industry were screened as well as 116 other chemicals. It was hoped to incorporate some good cercaricidal agent with one of these bases that gives some protection in itself. By June 18, 1954, of the total of 135 preparations, 34 gave complete protection to mice when the shaved belly surface was exposed to 100 cercariae of *S. mansoni* for 30 minutes.

When 100 percent protection was encountered in the preliminary screening tests: (1) related compounds were checked, and (2) 15 additional test and 10 control mice were exposed. *In vitro* tests were run with cercariae of *S. mansoni* on all ointments and their constituent parts that still gave complete protection on the second test run. This was followed by further experiments to determine the length of the protective period of each test ointment. Eventually animals protected with the best ointments will be tested against cercariae of *S. japonicum* and *S. haematobium*. Toxicity studies will be made and those which are safe to use will be tested on man in an area endemic for "swimmer's itch." Definitive testing will be carried out in areas endemic for schistosomiasis.

87. *Effectiveness of Abbott's Insect Repellent Cream (E-4856) as a Protective Barrier against* Schistosoma mansoni *in Mice.* Preston M. Bauman, Army Medical Service Graduate School; Luis Berrios Duran, Tropical Research Medical Laboratory; and Donald B. McMullen, Army Medical Service Graduate School.

A single application of Abbott's Insect Repellent Cream (E-4856) applied to the skin of the tail of mice prior to exposure to cercariae of *S. mansoni,* by the tail immersion technique, completely prevented infection through a 6 hour period and was highly effective through a 12 hour period. There was significant protection afforded mice when exposed 24 hours after a single application of the test cream when the animals had every opportunity to cleanse themselves in the 23 hour interval between treatment and exposure to cercariae. Evidence of protection persisted as long as 72 hours despite 3 daily soakings of the treated area prior to exposure. No residual effect was noted beyond the 72 hour period.

88. *A Physiographic Correlation of Freshwater Habitats and the Distribution of* Australorbis glabratus *in Puerto Rico.* Harold W. Harry and Billy G. Cumbie, Tropical Research Medical Laboratory, San Juan, Puerto Rico.

On the basis of topography, substrate material and climate, three major physiographic provinces are recognizable in Puerto Rico. Each has distinctive types of freshwater habitats, with varying potentials for maintaining *Australorbis glabratus* and consequently *Schistosoma mansoni.*

Complex Cretaceous rocks of volcanic origin, accompanied by limestones and shales, and intruded by massive granite and serpentine, constitute the greater part of the island. Relief is generally steep in such areas. High gradient streams and artificial reservoirs are almost the only types of freshwater habitats, and they are essentially negative for *Australorbis.* Low gradient streams occur in the province where the Caguana peneplane has beveled the area, and these do harbor the snail.

The Tertiary limestone belt of the north coast contains streams essentially free of *Australorbis* but has sink-ponds which often contain the snail. Schistosomiasis, however, is very rare in this area. The limestone belt of the south coast has few habitats for the snail, possibly because of its limited extent and arid climate.

Alluvial areas occur along the coast at the mouths of all larger streams, and in some isolated upland valleys. The variety of freshwater habitats include low-gradient streams, non-flowing waters which are by-products of stream meandering, and coastal lagoons. Many of these contain *Australorbis.* Low gradient streams of the coastal and upland alluvium are the chief sites of schistosomiasis in Puerto Rico.

89. *Host-Parasite Relationships between* Australorbis glabratus *and the Trematodes Infecting it in Puerto Rico, with Special Reference to* Schistosoma mansoni. Harold W. Harry and Billy G. Cumbie, Tropical Research Medical Laboratory, San Juan, Puerto Rico.

Between May, 1953 and May, 1954, 55 freshwater stations were sampled at random in Puerto Rico for the occurrence of trematodes in *Australorbis glabratus.* Four species of trematode parthenitae and four species of metacercariae have been found developing in this snail. *Schistosoma mansoni* was found at only 6 (10%) of these stations, actually representing only 4 distinct areas of the island. Five of these 6 stations were resampled several months after the original examination. On the basis of these studies a classification of freshwater habitats of Puerto Rico, from the standpoint of the epidemiology of schistosomiasis, has been proposed. *Cercaria marini* Faust and Hoffman occurred at 15 (27%) of the stations. *Cercaria paucispina* Faust and Hoffman was found only once. *Cercaria neotropicalis* Faust and Hoffman was found in both *A. glabratus* and *Tropicorbis riisei.* Each species of metacercaria found was limited to a distinct location within the host. One is evidently the tetracotyle of *C. neotropicalis,* another the metacercaria of *C. marini,* and the other 2 are presumed to undergo parthenital development in *Drepanotrema anatinum.*

90. *Effect of Snail Maintenance Temperatures on Development of* Schistosoma mansoni. M. A. Stirewalt, Naval Medical Research Institute.

The snail *Australorbis glabratus* was maintained after exposure to 1 or to 5 miracidia of *Schistosoma mansoni* at the following temperatures: 23–25°, 26–28°, 31–33°, 33–35°, and 36–38° C. Temperatures between 26 and 33° C. were optimal for parasitic development. Higher temperatures increased snail mortality. Lower temperatures reduced the proportion of snails in which infections developed to cercarial production, lengthened the prepatent period, suppressed cercarial production, shortened the duration of infection, and depressed infectivity of the schistosomes for mice as shown by their poor penetration and maturation.

91. *Survival and Weight Loss of* Australorbis glabratus *from Pernambuco, Brazil, when Kept out of Water at Various Relative Humidities.* Louis Olivier, National Institutes of Health; and Frederico S. Barbosa, Instituto Aggeu Magalhaes, Recife, Brazil.

Snails kept in open, shallow, clay jars at high relative humidities (about 85 to 95%) and 25 to 29° C. survived as long as 233 days without water. Snails on dry soil in large wooden boxes at about 70 to 80% relative humidity and 25 to 29° C. survived as long as 153 days.

Snails were kept in closed glass jars at known humidities produced by saturated solutions of salts in contact with the solid phase. At very high relative humidities (92 to 96%) the snails lost weight very slowly and lived relatively long. In one experiment the snails at these humidities averaged 90% of their original weight after 94 days, and some lived for over 200 days. At relative humidities of 82 percent and lower the snails always lost more weight and died more rapidly. Some snails lived over 100 days at about 56% relative humidity and over 50 days at 0–5% relative humidity. Apparently the snails must be maintained in a relatively humid atmosphere in order to survive long periods out of water. Few snails survived after loss of 40% their original weight. At this time they were usually retracted about one whorl into the shell. However, some snails were still alive after they had retracted to the extent of one and one-fourth whorls.

The ability of this species to survive for long periods out of water under certain conditions is of obvious importance in the epidemiology of schistosomiasis mansoni in Pernambuco and also makes control of the snails more difficult.

92. *The* in vitro *Activity of Schistosome Cercariae and Miracidia in Serum from Experimental, Natural, and Immunized Hosts.* Irving G. Kagan, The University of Pennsylvania.

Cercariae and miracidia of *Schistosoma mansoni* and *Schistosomatium douthitti* were placed in serum obtained from 7 monkeys exposed to infections of *S. douthitti* and 2 with *S. mansoni,* from 5 patients with *S. mansoni* and 1 with *S. haematobium,* and from rabbits immunized with antigens from the life cycle of *S. mansoni* and *S. douthitti.* The appearance of circumcercarial membranes around cercariae and the ability of dilute serum to immobilize miracidia constituted a positive test for schistosome antibody.

Serum of 5 monkeys exposed to *S. douthitti* showed weak to no activity with cercariae and miracidia of *S. douthitti* and *S. mansoni.* Serum from 2 monkeys showed strong reactions against cercariae of both species and immobilized the miracidia of *S. douthitti* at titers of 1:100 with no activity against miracidia of *S. mansoni.* Serum from 2 monkeys infected with *S. mansoni* showed strong activity against cercariae of both species and immobilized miracidia of both species at titers of 1:25–1:100.

Serum of 5 humans with histories of *S. mansoni* showed little activity against cercariae but immobilized miracidia of *S. douthitti* at titers of 1:25–1:100. Circumcercarial membranes formed around cercariae of *S. mansoni* in serum from a patient with *S. haematobium.*

Rabbits were immunized with antigens prepared from the following life cycle stages of *S. douthitti:* male worms, male and female worms, spleens with many eggs from heavily infected mice and miracidia. Antigens prepared from life history stages of *S. mansoni* were sexually mature female worms, sexually immature female worms (from unisexual infections), male worms, and lyophilized, frozen and fresh cercariae homogenates. Circumcercarial membranes with cercariae of both species were obtained with anti-*S. douthitti* miracidium serum and antiserum prepared with *S. mansoni* antigens. Miracidia of *S. douthitti* were immobilized at titers of 1:400 with anti-*S. douthitti* miracidium serum and at titers of 1:25–1:100 and with antisera prepared with *S. mansoni* antigens.

93. *The* in vitro *Activity of Cercariae of* Schistosoma mansoni *in Serum of Normal and Immunized Animals.* Donald M. Levine and Irving G. Kagan, The University of Pennsylvania.

The *in vitro* activity of fresh and inactivated serum from cat, chicken, cow, dog, guinea pig, goat, horse, hamster, mouse, monkey, pigeon, pig, rabbit, rat and sheep was tested against cercariae of *S. mansoni* prior to and after immunization with a cercarial antigen. Normal serum of man, steer and squirrel was also tested. Fresh serum immobilized cercariae and for some species was not cercariacidal for many hours. Cercariae were killed within 12 hours in normal serum of rat, chicken, pigeon, dog, sheep, and guinea pig. Fresh horse serum agglutinated cercariae. Serum inactivated at 57° C. for 30 minutes lost the ability to immobilize cercariae and agglutination of cercariae was then observed in normal cow, sheep, steer, goat, dog, and pig serum.

All species tested were immunized successfully with biweekly intravenous injections of a homogenate of 200–30,000 frozen cercariae of *S. mansoni.* Circumcercarial membranes were

observed in cat serum after one injection, in chicken, pigeon, and rabbit after two injections, in horse, cow, sheep, goat, and monkey after three injections, in mouse, rat, hamster, and pig after four injections, and in guinea pig and dog after five injections of antigen. During the course of immunization all species showed an inactivated serum agglutination of cercariae.

94. *Longevity of* Schistosomatium douthitti *Miracidia.* James H. Oliver, Jr. and Robert B. Short, Florida State University.

Longevity data were recorded for 1140 miracidia of *Schistosomatium douthitti.* These miracidia were obtained from the ground livers of 9 mice (6 C3H strain; 3 albino) by the side arm flask method of McMullen and Beaver (1945). The mice had been infected with more male than female worms to insure, insofar as possible, fertilization of eggs; the infections were 51 to 108 days old. Actively swimming miracidia were placed in stender dishes (5 per dish) and were examined every hour until dead. Filtered Wakulla River water was used for hatching miracidia and determining their longevity. The temperature ranged from 22.2 to 24.4° C.

Twenty-five percent of the miracidia had died before the end of the third hour, 50% by the end of the ninth hour, and 75% by the sixteenth hour. A few lived for 24 hours but all were dead at 25 hours. Two death rates are apparent. The first is a gradual one; the second, beginning at about 17 or 18 hours is very rapid.

95. *Gametogenesis in* Schistosomatium douthitti (*Cort*). Martha Malone Nez, Florida State University.

Spermatogenesis and oögenesis in *Schistosomatium douthitti* were studied with special attention to the chromosome morphology and behavior, the structure of the reproductive organs and the arrangement of the germ cells within them. Fertilization, and the first two cleavage stages also were studied.

The oöcytes within uterine eggs are in the diffuse condition in which they left the ovary. Development resumes only after the eggs are laid in the host tissues.

Spermatogenesis in *Schistosomatium douthitti* differs from that in *Schistosoma haematobium, S. japonicum,* and *S. mansoni* in one basic aspect; namely in *S. douthitti,* the male germ cells remain joined, forming eventually a rosette of 32 spermatids as occurs in hermaphroditic flukes. In the other schistosomes the cells break apart after each division. The mature spermatozoa possess two flagella derived from cytoplasmic extensions of the spermatids.

The diploid chromosome number in both male and female germ cells and in somatic tissues of both sexes is 14. The primary spermatocytes and oöcytes contain 7 bivalents. The chromosome complement is: 2 pairs of long metacentric chromosomes; 4 pairs of shorter telocentric to subtelocentric chromosomes, and 1 pair of very small chromosomes. No sex chromosomes were identified.

96. *Observations on Schistosome Dermatitis in Interior Alaska.* Reinhard Harkema, North Carolina State College.

The survey of Alaskan schistosomes of military-medical importance resolved itself into a collection of snails. A total of 80 bodies of water was investigated during the summers of 1952 and 1953. Twenty were found to harbor snails infected with itch-producing cercariae. Infested sites were in the Fairbanks area, Yukon Flats, near the Tok and lower Alaska Highways. Ten species of snails were found and *Lymnaea palustris, L. stagnalis* and *L. auricularia* were found to harbor cercariae.

Two species of cercariae were found. These differ in detailed measurements and in behavior. Both are positively phototropic and attach by the ventral suckers. One form attaches to the lighted side and surface of illuminated glass jars, the other to the lighted side and bottom. No attempt is made to name these forms at the present time. Descriptions are given, however. Both forms possessed itch-producing properties.

Several cases of schistosome dermatitis were noted in the Fairbanks area and in the vicinity of Fort Yukon.

Adult male specimens of flukes were found in 2 baldpate ducks collected at Minto Lake.

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97. *The Life Cycles of* Alaria arisaemoides *Augustine & Uribe, 1927, and* Alaria canis *LaRue & Fallis, 1936 (Trematoda: Diplostomidae), Parasites of the Red Fox,* Vulpes fulva (*Desmarest*). J. C. Pearson, Ontario Research Foundation.

The life cycles of both species were followed experimentally in laboratory- (or ranch-) raised animals. The miracidium of *A. arisaemoides* penetrates and develops in *Planorbula*

armigera and *Promenetus exacuous,* while the miracidium of *A. canis* develops in *Helisoma trivolvis* and *H. campanulata.* There is some evidence which suggests that the mother sporocysts, in both species, persist and produce daughter sporocysts for as long as a year. Both mother and daughter sporocysts are parasites of the blood-vascular system. Cercariae emerge actively, largely from the pseudobranch, 18 to 30 days after infection of the snails; they readily penetrate tadpoles of *Bufo americanus, Rana pipiens, Rana sylvatica* and *Rana clamitans.* In the first 3 species, the cercariae become mesocercariae in about 3 weeks, while in the last, they fail to mature and disappear from the tissues. A few cercariae will penetrate into frogs of *R. pipiens* and develop, and a few will penetrate into the larvae of *Triturus v. viridescens, Ambystoma jeffersonianum* and *A. maculatum,* but fail to develop in them. Cercariae do not penetrate fish, snakes and laboratory mice. When fed to a fox, mesocercariae migrate, apparently by way of the serous cavities, to the lungs, where they become unencysted diplostomula, which in turn make their way through the bronchi and trachea to the gut where they mature in the small intestine. The time from the feeding of mesocercariae to the first appearance of eggs in the feces is about 35 days. When mesocercariae are fed to laboratory mice, deer mice (*Peromyscus maniculatus*), ferrets, ducklings, and chicks, they migrate into the tissues and encyst, without developing further. Encysted mesocercariae were found alive in ferrets and birds which were killed one month after feeding and in mice which were killed one year after feeding.

98. *The Development of a Species of* Opistholebes *in the Final Host, the Affinities of Some Amphistomatous Trematodes from Marine Fishes, and the Allocreadioid Problem.* R. M. CABLE, Purdue University.

In developing from the metacercaria to the adult in the intestine of the porcupine fish, *Diodon hystrix,* the body of a species of *Opistholebes* changes from distome to amphistome in form as a result of differential growth. Hence the amphistomatous plan is considered to be secondary phylogenetically in the OPISTHOLEBETIDAE and probably also in the GYLIAUCHENIDAE and CEPHALOPORIDAE as all of these families contain genera ranging from distome to amphistome in adult form. These groups, instead of being related to the paramphistomes, seem instead to be aberrant relatives of other well known groups. Evidence is presented that the OPISTHOLEBETIDAE and OPECOELIDAE have close affinities as a group distinct from others of the allocreadioid complex which is considered to be polyphyletic. It is suggested that the GYLIAUCHENIDAE are related to the LEPOCREADIIDAE and that the CEPHALOPORIDAE are an aberrant group of the PLAGIORCHIOIDEA. (also presented by demonstration—see No. 75).

99. *Monogenetic Trematodes of Some Gulf of Mexico Fishes.* W. J. HARGIS, JR., Florida State University.

The present paper is a preliminary report of the results of a recent study of the monogenetic trematodes taken from 313 individuals of 49 species of fish. While the results are not actually monographic, this study is very comprehensive in scope and contains data from one of the largest collections of monogenetics ever made in one continuous period from marine waters of the United States.

Forty-seven new species are described and 27 previously reported forms discussed. Redescriptions of 6 species are made from the type material. Nine new genera and 2 new subfamilies are proposed. New combinations are made in the diagnoses of 11 genera, 4 subfamilies and 3 families.

Using the previously established homology of clamp sclerites as a basis, the theory is propounded that members of the family DICLIDOPHORIDAE evolved from a form similar to some *Tagia* spp. (family DISCOCOTYLIDAE). In addition, the hypothesis that *Pyragraphorus* evolved from *Microcotyle,* or some form similar thereto, is proposed.

Monogenetic host-specificity is considered and the fact that it is very striking in nature confirmed. An attempt at understanding the limits and some of the factors involved in specficity is made. Although some interesting data result, the conclusion is reached that much study remains to be done before monogenetic host-specificity is understood. This specificity appears to be more rigid in marine habitats than in fresh-water and probably involves ecological and/or phylogenetic considerations. (also presented by demonstration—see No. 76).

100. *A New Trematode from the Lesser Panda,* Ailurus fulgens. EMMETT W. PRICE, Animal Disease and Parasite Research Branch, A.R.S., U.S.D.A., Beltsville, Maryland.

On April 27, 1927, an opportunity was afforded to examine the viscera of a young adult *Ailurus fulgens* which died in the National Zoological Park, Washington, D. C. An examination of the washings of the intestine revealed a single specimen of a notocotyloid trematode which upon subsequent study was found to belong to the genus *Ogmocotyle* Skrjabin and Schulz,

1933 (syn. *Cymbiforma* Yamaguti, 1933), and for it the name *Ogmogaster ailuri* is proposed. A brief description of the parasite follows:

Body scoop-shaped, 1.3 mm. long by 0.73 mm. wide; cuticle smooth. Oral sucker subterminal, 0.112 mm. in diameter. Genital aperture sinistral, 0.64 mm. from anterior end. Cirrus pouch large, crescent shaped; testes 0.288 mm. long by 0.96 mm. wide. Ovary deeply lobed, 0.11 mm. long by 0.24 mm. wide, situated between posterior ends of testes; vitelline follicles forming band across body anterior to ovary and testes; uterine coils occupying greater part of area between testes and transverse part of cirrus pouch; metraterm muscular. Egg 0.018 mm. long by 0.011 mm. wide, with long, stout filament at antopercular pole and with 2 slender, short filaments at opercular pole.

Of the three species included in *Ogmogaster, O. pagargi* Skrjabin and Schulz, *O. sikae* (Yamaguti) and *O. indica* (Bhalerao), the proposed species differs from them mainly in having eggs provided with 2 opercular filaments instead of the customary single filament.

It may be of interest to note that all species except the one reported herein are from wild and domestic ruminants. (also presented by demonstration—see No. 78).

101. *Homoplastic and Heteroplastic Transplantation of Gorgoderine Trematodes.* Chauncey G. Goodchild, Emory University.

Gorgoderina attenuata and *Gorgodera amplicava* were homoplastically and heteroplastically transplanted into various sites in the frogs, *Rana pipiens, R. catesbeiana,* and *R. sylvatica.* Homoplastic and heteroplastic bladder-to-bladder transplantations were made without noticeable ill-effects on parasites retained intravesically for periods up to 21 days. In sharp contrast to this success was the quick death of flukes placed experimentally elsewhere in the frogs. Parasites implanted into the conjunctival sac and into the anterior chamber of the eye exhibited signs of life for only 30–40 hours. Deteriorative sloughing of the cuticula, and attack and infiltration by phagocytes of the host gradually reduced the parasite to an amorphous mass by 96 hours post-implantation. Parasites transplanted into vocal sacs, dorsal lymph spaces, and abdominal coelom also succumbed usually within 24 hours. In the former site, flukes recovered after 2–3 days were swollen, had hypertrophy of the acetabulum, and showed general disintegration and sloughing of tissues; while in the latter sites, host cells had encapsulated and cemented the parasite to the integument or peritoneum by 48–72 hours. Flukes transplanted into lungs through the glottis or through lateral incisions died within 24–50 hours. Slightly greater longevity occurred in the former transplants (24–36 hours), than in the latter (up to 24 hours). Maximum survival (approximately 50 hours) occurred in glottal transplants in which the tracheae were subsequently plugged or sutured to exclude air. These flukes alone, of all the implants, had any semblance of normal locomotion and sucker activity.

102. *Biology and Distribution of* Opisthorchis viverrini *in Thailand.* Elvio H. Sadun, Communicable Disease Center, Public Health Service, U. S. Department of Health, Education, and Welfare, Atlanta Georgia.

Trematode eggs found in fecal examinations of humans and cats in various provinces in Thailand were morphologically quite alike and similar to those described for *Opisthorchis viverrini.* The average size of eggs from cat feces was 27 by 15 microns with extremes 17–31 by 12–16 microns. The adult flukes from human and cat sources were also quite alike and fitted the description of *O. viverrini.* They measured on the average 7 by 1.5 mm. and 4.6 by 2 mm. respectively.

On the basis of over 26,000 stool examinations, it was found that *Opisthorchis* infection is endemic in humans in all the provinces surveyed in the North and Northeast Thailand but not in any part of the Central and South Regions. The most important endemic areas are to be found in the Mekong Valley. In the areas of heavy infection about one-half of persons examined harbored this infection. The highest incidence (88.5%) was found in villages situated around a small lake in Udorn province. A striking difference in the incidence of infection was observed between the Siamese and Chinese in one city being 50.4 and 2.9 respectively. No significant difference was found to exist between sexes and between urban and rural populations. The intensity of infection as measured by egg counts closely paralleled the incidence findings. A gradual increase in the incidence and intensity of infection with age was observed. It is estimated that between one and a half and two million persons have liver fluke infections in Thailand, most of them living in the Northeast. (This work was done under the auspices of the Special Technical and Economic Mission to Thailand, Foreign Operations Administration.)

103. *The Epidemiology of* Opisthorchis viverrini *in Thailand.* Elvio H. Sadun, Communicable Disease Center, Public Health Service, U. S. Department of Health, Education, and Welfare, Atlanta, Georgia.

Raw fish is frequently eaten in Thailand particularly by the Laos living in the Northeast

and in the North regions. When cats were fed some of the common raw fish dishes sold at a market for human consumption, infection with the liver fluke was produced.

The difference in incidence and intensity between the Siamese and Chinese living in the same town, and between people at different age levels was related primarily to their dietary habits.

Cats and dogs were found naturally infected with *Opisthorchis* not only in those regions where liver fluke is highly endemic in man but in Central Thailand as well where indigenous human infections were never encountered. Close observation of 143 persons in a highly endemic village indicated that symptoms in human opisthorchiasis are progressively increasing in severity as the infection becomes older and as the flukes are gradually acquired. No marked eosinophilia was found to be associated with the infection. Liver cirrhosis and carcinoma of the bile ducts were often observed among the people living in the Northeast. In 4 adult males infected with *Opisthorchis* a diagnosis of carcinoma of the bile ducts was established at autopsy. One of them harbored 5,896 adult flukes. Whether or not the association between liver fluke infection and carcinoma of the bile ducts was a causal relationship could not be determined by the present studies. (This work was done under the auspices of the Special Technical and Economic Mission to Thailand, Foreign Operations Administration).

104. *Antigenic Potency of Cell-Free Extracts of Leptospires.* Morris D. Schneider, The Veterinary Section, Third Army Area Medical Laboratory, Fort McPherson, Georgia.

Virtually all of the determinant of complement fixation reactivity of the leptospire cell has been recovered in two polysaccharide-containing cell-free preparations. This report is limited to studies of antigenic potency *in vivo* in rabbits of aqueous (Fraction 1) and alcoholic (Fraction 2) cell-free extracts of *Leptospira bataviae* and *Leptospira icterohemorrhagiae.* Fraction 1 is shown to be immunogenic as well as antigenic, as determined by complement fixation and agglutination-lysis reactions. Fraction 2 behaves as a typical hapten. It reacts strongly in the complement fixation test with homologous hyperimmune serum, but poorly with heterologous hyperimmune and antifraction 1 and 2 sera. It appears to be non-antigenic *in vivo* in the rabbit. A possible practical application of Fraction 1 preparation in improving diagnostic technique and distinguishing serotypes is discussed. Based on the evidence presented, it appears highly probable that the cell-free extracts of the leptospire organism contain independent antigen systems.

105. *Host-Virus-Mosquito Relations of Shope's Fibromas in Cottontail Rabbits.* Lawrence Kilham and Herbert T. Dalmat, Laboratory of Infectious Diseases and Laboratory of Tropical Diseases, Microbiological Institute of the National Institutes of Health, Public Health Service, Bethesda, Maryland.

Laboratory studies have been continued in an effort to reconstruct what may be the natural cycle of infection and transmission of the virus of Shope's fibromas among cottontail rabbits.

Fibroma virus was transmitted by the bite of *Anopheles quadrimaculatus, Culex pipiens,* and *Aedes triseriatus* as readily as by the bite of *Aedes aegypti,* following which fibromas similar in appearance to those of natural occurrence are produced on the feet and legs of cottontails. A young cottontail, inoculated when a month old, had fibromas which were still infective for *Aedes aegypti* 10 months later and which contained a high concentration of virus a year after inoculation. A wild cottontail had naturally acquired fibromas which remained infective for mosquitoes from December to April, suggesting that cottontails could serve as effective reservoirs of infection.

No fibromas developed from the bites of *Aedes aegypti* when the mouthparts were previously treated with a suspension of virulent fibroma virus. There was no evidence that this virus could persist on the exteriors of these mosquitoes as suggested by the "flying pin" theory of other investigators. Likewise, virus could not be recovered from the bodies of mosquitoes that had been inoculated with a suspension of fibroma and defibrinated guinea pig blood. On the contrary, tumors were produced by inoculating into rabbits a suspension of heads of mosquitoes that had previously fed on the same virus-blood preparation.

By inoculating into test rabbits pooled mosquito heads, thoraces, and abdomens at various intervals of time after the mosquitoes had fed on cottontail fibromas, it was shown that considerable virus remained in the mosquito for at least 5 weeks, and that it was localized entirely in head parts. Mosquitoes that had fed on cottontail fibromas were able to produce tumors upon 5 repeated feedings from 1 to 18 days after their initial infective meal with no striking reduction of virus content. Only a 10-fold diminution of titer was noted as compared with controls which were tested for virus titer on day 1.

Since mosquitoes feeding on cottontail fibromas imbibe neutralizing antibodies with blood meals and have no virus in their salivary glands, virus-mosquito relations are different from those

encountered in yellow fever and the virus encephalitides. Evidence for and against a biological cycle of fibroma virus in the mosquito is discussed.

106. *The Challenge of Helminthic Parasitism in Veterinary Chemotherapy.* A. O. Foster, Animal Disease and Parasite Research Branch, ARS, USDA.

With increasing knowledge of the insidious ways in which helminths cause their greatest economic impact on the livestock industry, there are also increasing instances in which helminths are principal agents in disease-outbreaks marked by severe morbidity and deaths. The loss from worm parasites—possibly four hundred million dollars annually in the United States—exceeds that from both protozoa and arthropods in all livestock except cattle. Anthelmintics and related chemical measures offer the most powerful means for minimizing the loss. The situation among protozoan and arthropod infections is only comparatively better; agents against the former are largely in the experimental stage, and those against arthropods present primarily problems of toxicity, formulation, application, and use. The significantly favorable aspect is that reasonably reliable measures can be employed against most of the injurious species. In the anthelmintic area, however, no treatments of any kind may be recommended against some 90 of about 145 species injurious to food animals. Of those that may be recommended, moreover, grave deficiencies are evident even in the best. Current problems concern limitations and expanding uses of phenothiazine, failures of anthelmintics against immature worms and in weak animals, lack of chemical agents against extra-intestinal helminths, conservatism in methods of attacking helminths, scarcity of "polyvalent" anthelmintics, and the paucity of critical information and comparative evaluations. Basic problems must also be solved regarding criteria and standards of testing, validation of "screen-tests" and mechanism of action.

107. *Studies on the Biology of* Taenia crassiceps *(Zeder, 1800) Rudolphi, 1810.* Reino S. Freeman, Ontario Research Foundation, Toronto, Canada.

Adult *Taenia crassiceps* (Zeder, 1800) Rudolphi, 1810 were found in 27 of 78 *Vulpes fulva* taken from various parts of Southern Ontario. The larval stage (*Cysticercus longicollis* Rudolphi, 1819) was found in 1 of 18 *Tamias striatus* and 4 of 6 *Microtus pennsylvanicus* from an area where the adult worm is known to occur; 1 *Sciurus carolinensis,* 5 *Tamiasciurus hudsonicus,* 13 *Peromyscus maniculatus gracilis,* 1 *Sorex cinereus,* and 1 *Marmota monax* from the same area were negative. An *Ondatra zibethicus* from another area also was found infected. No infection with this species of worm was found in over 500 rodents and shrews of various species and 9 *Vulpes fulva* taken from Algonquin Park, Ontario, and its immediate vicinity. The following species were infected by feeding *T. crassiceps* eggs in the laboratory: *Mus musculus, Peromyscus maniculatus* sspp., *Sciurus carolinensis* and *Tamias striatus;* attempts to infect 4 *Cavia porcellus,* 5 *Oryctolagus cuniculus,* 1 *Lepus americanus,* 1 *Ovis aries,* 2 *Clethrionomys gapperi,* 1 *Tamiasciurus hudsonicus,* and 1 *Napaeozapus insignis* were unsuccessful.

Observations on the host-parasite relationship as well as the course of larval development were made, particularly in laboratory *Mus musculus,* following either the feeding of tapeworm eggs or the subcutaneous, intraplural, or intraperitoneal inoculation of larvae, or their parts, in various stages of development. Mature cysticerci were obtained in as short a time as 5 weeks. Exogenous budding, usually from the non-scolex pole of the cysticercus, was found normal for this species, but endogenous buds were observed also. Gravid worms were recovered within 5 weeks after cysticerci were fed to foxes and dogs; 2 coyotes (*Canis latrans*) failed to become infected.

108. *New Species in the Genus* Corallobothrium *Fritsch 1886.* Arthur W. Jones and Clayton Kerley, The University of Tennessee; and Kermit R. Sneed, The University of Oklahoma.

Specimens of *Corallobothrium* from Tennessee and Oklahoma are reported which differ from known species, and which, because of sphinctered suckers, suggest subdividing the genus into subgenera differentiated chiefly on the above scolex character. The subgeneric name *Megathylacoides* is proposed for the sphinctered species group, in recognition of a possible relationship to the sphinctered proteocephaline *Megathylacus* Woodland 1934, while the name *Corallobothrium* is retained for those species lacking sphincters.

109. *An Anatomical Explanation of "Apolysis" in the Cestode* Multiceps packi *Christenson, 1929.* Elon E. Byrd, University of Georgia.

(no abstract submitted)

110. *Attempts at* in Vitro *Cultivation of the Fowl Cestode,* Raillietina cesticillus. Charles F. Smith, Swift & Co., Research Laboratories, Chicago, Illinois.

Cysticercoids of *Raillietina cesticillus* evaginate: (1) under mechanical pressures, (2)

frequently in chicken bile or a detergent (trisodium phosphate), (3) infrequently in water, Ringer's solution (warm), sodium taurocholate or iron bile salt. Evaginated scoleces may be kept alive 9 hrs. in Ringer's-glucose-corn starch solutions. Evagination occurs more rapidly and frequently at 7°C. or 40°C., less so at room temperatures. The phenomena of evagination appears to be, in part, cyst metabolism resisting diffusion of fluids into the bladder. This resistence is altered by high and low temperatures and/or surface active agents. Diffusion of liquids into the bladder appears to increase internal pressures and cause or aid evagination.

Adult *R. cesticillus* were kept alive 60 hrs. in liquid solutions of Ringer's-glucose-corn starch at 40°C. Solid or semi-solid media did not support life and in 4 hrs. showed much bacterial growth. Sterile cultures of adult *R. cesticillus* were obtained by immersion of the cestodes in solutions of streptomycin sulfate before introduction into sterile solutions. A difference was noted in survival time between sterile and non-sterile cultures, the latter being longer. Cestodes under sterile conditions displayed more activity and appeared to have more vitality. Vitamins and chicken serum were toxic in high concentrations but in lower concentrations increased strobila activity. Constant mechanical stimulation also increased strobila activity but did not lengthen survival time. Strobilae without scoleces and with constant mechanical stimulation remained active for 40 hrs.

It was felt that chicken serum, vitamins, Ringer's-glucose-corn starch solutions under constant mechanical stimulation at 40°C. provided the most successful environment of any tried for this cestode. It is suggested that bacteria may be a necessary constituent of this cestode's environment, perhaps having symbiotic relationships.

(This work was done during June-October, 1953, at Ohio State University with support of a Mary S. Muellhaupt postdoctoral research scholarship.)

110a *A Difference in the Susceptibility of Male and Female Hamsters to Infection with the Rat Nematode,* Nippostrongylus muris. A. J. Haley, The Johns Hopkins University.

Nippostrongylus muris is capable of attaining sexual maturity in hamsters, but development is considerably less than in the normal host laboratory rat. In addition, it has been found that a significantly greater percentage of worms develops in male hamsters than in female hamsters. The percentage development in 15 male hamsters ranged from 4 to 12 with a mean of 7.5. In 10 female hamsters of comparable age the percentage development ranged from 0 to 1 with a mean of 0.4. Further characterization of the sex difference is in progress.

111. *Acquired Immunologic Resistance against* Schistosoma japonicum. S. Lin, L. S. Ritchie, and G. W. Hunter, III, 406th Medical General Laboratory, APO 500.

Beginning in 1950 and continuing through 1953, a series of experiments were carried out to determine whether any resistance is acquired by mice and hamsters from light infections of *Schistosoma japonicum.* In addition to evidence from superinfections, tests for resistance were made following injections of whole-worm saline antigens.

Because of the difficulty in distinguishing the worms of the immunizing and challenging infections, a series of control animals was established for each exposure. It was necessary to assume that if no immunity resulted, the mean number of adult worms recovered from the experimental animals, receiving (for example) 10 and 20 cercariae as immunizing exposures and 40 cercariae as the challenge, should equal the sum of the mean worms from separate sets of controls that were given 10, 20, and 40 cercariae respectively.

Of a series of 6 experiments—testing for evidence of resistance to superinfection—the first 2 involved a 6-week immunizing period with 2 bisexual exposures, 3 weeks apart. Following challenging exposures, worm burdens were 37 and 27% less in experimental mice and hamsters, respectively, than the 3 sets of controls, collectively. In the third experiment (hamsters) half the animals received one exposure of cercariae from single snails, while half received mixed cercariae. With an intervening immunizing period of 4 months, the worm count following superinfections were reduced 32 and 37% respectively. This suggested that monosexual infections afforded as much resistance as bisexual ones, and in subsequent work only the former were used to avoid pathologic damage to the host due to eggs. In the fourth experiment (mice) following immunizing exposure of 3 months duration, a worm reduction of 41% occurred. The fifth and sixth experiments were similar to the fourth except that the immunizing periods were 6 and 8 months, for which worm burden reduction of 34 to 26% were obtained.

In the first of 2 series of 22 mice receiving 8 weekly injections of whole-worm saline antigen (0.1 ml. of a 1 : 1000 dilution), the worm burden was 34% less than that for 22 equally exposed normal controls. For the second series of 15 mice which received 14 injections of antigen the number of worms recovered was 56% less than from controls.

112. *Studies on Schistosomiasis.* VIII. *Failure of Copper Oleate to Protect Mice Against the Penetration of the Skin by Cercariae of* Schistosoma mansoni, Arthur P. Moon and George W. Hunter, III, Fourth Army Area Medical Laboratory, Brooke Army Medical Center, Fort Sam Houston, Texas.

Copper oleate protected mice against penetration of cercariae of *Schistosoma japonicum* (Hunter, Kaufman and Pan, 1952, J. Exptl. Parasit. **1:** 168) and protected man against the cercariae of bird schistosomes (Hunter, *et al* 1952, Tr. Roy. Soc. Trop. Med. and Hyg. **46:** 201). However, experiments utilizing the same techniques failed to protect shaved white mice exposed for 30 minutes to the cercariae of *S. mansoni. In vitro* tests yielded similar results to those secured in Japan but *in vivo* tests gave unsatisfactory results. The percent of relative protection varied as follows (the figure in parenthesis indicates the number of animals used) : 86.8% (24) ; 91.8% (50) ; 95.6% (22) ; 97.1% (17). Control mice were exposed to pools of all *S. mansoni* cercariae used and all were positive at autopsy.

113. *Persistence of Egg-Laying by* Oncomelania nosophora *Females Following Isolation from Males.* Yuri Otori, C. S. Sandiford and L. S. Ritchie, 406th Medical General Laboratory APO 500.

An investigation is in progress to determine how long *Oncomelania nosophora* can continue to lay fertile eggs after isolation from males. This is of importance in respect to the possibility of snail repopulation of areas in which virtual eradication has been achieved by molluscicides or other means. Another aspect of the investigation is to compare reproductive capacity of females isolated during different seasons of the year.

Single females were isolated on filter paper in small petri dishes, of which a portion were paired with males during spring and summer. Males were removed from all dishes at the end of fall, thus interrupting copulation much as it would be under natural condition of hibernation. Since the eggs were not easily seen in the mud cakes, which were included as a laying site, reproduction was based on the number of young which hatched.

During the first summer under experimental conditions, the isolated females reproduced as many young as those which were paired with males, indicating that copulation of the preceding fall or before had been adequate for normal reproduction. Females paired with males the first summer and isolated the second, showed increased reproduction during the second summer, assuring adequacy of laboratory conditions. Females in complete isolation during both first and second summers were capable of producing some young during the second summer, but the numbers were greatly reduced. On the basis of observations on three females, it appears that reproduction may not be possible during the third year of isolation.

114. *Schistosome Dermatitis in a South Florida Lake.* W. Henry Leigh, University of Miami.

In March 1953, Dr. Christian Keedy of Miami, Florida reported that his children, who had been swimming in an artificial lake, had experienced a severe dermatitis. Snails, identified as *Physa pumilio,* were collected from the swimming area and found to harbor 7 species of cercariae, one of which was a schistosome. The author experienced a typical schistosome dermatitis about the ankles while collecting the snails and subsequent exposure to the schistosome cercariae in the laboratory reproduced the dermatitis, leaving little doubt that the natural cases of dermatitis in this lake were of schistosome origin.

This apparently is the first record of swimmer's itch in Florida lakes which has been linked definitely to a cercaria. This cercaria resembles that of *Trichobilharzia physellae* (Talbot, 1936) and one of the reported hosts for that organism, the pintail duck, was one of several species of ducks reported on the lake during the winter of 1953–54. There was a repetition of the dermatitis in both children and adults during April and early May of 1954. No dermatitis occurred during the summer, fall or winter months of 1953. Other cases of dermatitis of probable schistosome origin have been reported by hunters wading in the marshes during the duck hunting season. Since South Florida is a wintering ground for blue-winged teal, pintail ducks and spoonbilled ducks, reported to be hosts of *T. physellae,* it would not be surprising to find that schistosome cercariae are more generally distributed than this one report indicates. (Supported by grant G-4051 from the National Institutes of Health).

115. *Host-Parasite Glycogen Relationships in* Haematoloechus medioplexus. Thomas D. Bair, Albany Medical College.

Parasites living in food-rich environments are offered two theoretical possibilities for maintaining their nutritional state. They may absorb nutrients passively from their surroundings with a relatively constant ratio between host and parasite nutrient concentration. They may also

actively absorb or reject material in their environment resulting in a situation wherein the concentration of nutrients in the parasite is completely independent of the concentration in the host animal. In order to determine which situation prevailed in the case of *Haematoloechus medioplexus,* a trematode parasite of the lungs of *Rana pipiens,* glycogen analyses were run on pooled worm samples and small pieces of liver from infected frogs.

The glycogen content of the parasites was relatively constant over the range of 0.50% to 1.37% wet weight while the glycogen store of the host animal varied rather uniformly from 0.31% to 2.73%. There was no constant relationship between the glycogen level in the parasites and the glycogen level in the liver of the host animal.

These data seem to indicate that *H. medioplexus* is capable of maintaining its own glycogen stores completely independent of those of the host animal. In some instances the parasite glycogen level even exceeded the glycogen levels of the host animal. There is no evidence, however, that this was not simply due to differences in metabolic rate rather than in storage rates.

116. *The Life Histories of* Phyllodistomum lohrenzi *Loewen, 1935, and* P. caudatum *Steelman, 1938 (Trematoda: Gorgoderinae).* Erwin R. Beilfuss, Macalester College, St. Paul, Minnesota.

Observations and experiments on these two life histories were conducted at Oklahoma A. & M. College, Department of Zoology from January, 1952 until August, 1953 and in the general area of Stillwater, Oklahoma.

Eggs passed from the definitive host *Lepomis cyanellus* Raf. in the urine hatched immediately, liberating free-swimming miracidia. Miracidia entered the clam *Musculium transversum* (Say) passively through the incurrent siphon and transformed into mother sporocysts in the gills. Mother sporocysts each produced a single generation of daughter sporocysts which gave rise to macrocercous cercariae. From miracidial entrance to cercarial production required about 2 to 3 months.

It was proven by anatomical studies, infection experiments and field observations that *Cercaria coelocerca* Steelman, 1939 is identical with the cercaria of *P. lohrenzi.* The cercariae encysted in one of two methods. (1) There was a suppression of the free cercarial stage; the cercariae did not emerge from their daughter sporocysts but shed their tails and subsequently encysted within the daughter sporocysts. (2) The cercariae were shed from the daughter sporocysts and emerged from the clam through the excurrent siphon. The cercariae were very active but unable to swim; movement consisted of vigorous lashings of the distal division of the tail. The vigorous cercarial activity served to lure Trichoptera larvae (*Oecetis cinerascens, O. inconspicua, Leptocella* sp.) which served as metacercarial hosts. Therefore, the green sunfish can be infected by ingesting infected clams or caddisfly larvae.

Metacercariae excysted in the small intestine of the green sunfish and were recovered from the urinary bladder and mesonephric tubules in 48 hrs. after ingestion of the second intermediate host. Two to three months were required for these bladder flukes to attain sexual maturity.

Life history stages of *Phyllodistomum caudatum* occurred as follows: adults in the urinary bladder of the black bullhead *Ameiurus melas* (Raf.); miracidia entered the clam *Musculium elevatum* (Haldeman); mother and daughter sporocysts in the clam gills; cercariae emerged from the daughter sporocysts or shed their tails and encysted as metacercariae within the daughter sporocysts. The cercariae shed from the clam were active swimmers; no second intermediate host involving these free cercariae was found. The cercaria of *P. caudatum* was found to be identical with *Cercaria raiacauda* Steelman, 1938.

117. *Acquired Immunity in Mice Infected with* Postharmostomum helicis *(Trematoda: Brachylaematidae).* Henry van Dyke, Carleton College, Northfield, Minnesota.

Immunity to superinfection was acquired by albino mice (NIH strain, Mrs. Ray Rawley, Detroit) against *Postharmostomum helicis* 25, 40, and 60 days after an initial infection (100 metacercariae per mouse). Immunity was ascertained by the recovery of worms 14 days after a challenging infection of 200 metacercariae per mouse. Worms developing from the challenging infection were reduced in number and stunted in growth as compared to worms in control mice. Resistance to superinfection did not increase with the duration of the 25–60 day initial infection. Adult *Postharmostomum helicis* were found attached to the host's cecal mucosa, and the intestinal ceca of the worms were filled with host blood.

118. *Variation in Size of* Postharmostomum helicis *(Trematoda: Brachylaematidae) in Different Rodent Hosts.* Henry van Dyke, Carleton College, Northfield, Minnesota.

The three species of rodent hosts (albino mice, albino rats, and laboratory-raised *Peromyscus maniculatus,* a natural host) used in these experiments were fed metacercariae at the level of

10 metacercariae per gram of body weight. Worms were handled by a standard procedure and were killed and fixed in hot 10% formalin without pressure. At autopsy 7 days after infection: worms from albino mice (5 having a mean weight of 14.6 grams) had a mean length of 1.998 mm.; worms from *Peromyscus maniculatus* (6 having a mean weight of 14.2 grams) had a mean length of 2.634 mm. At autopsy 14 days after infection: worms from albino mice (6 having a mean weight of 15.8 grams) had a mean length of 2.655 mm.; worms from albino rats (4 having a mean weight of 159 grams) had a mean length of 3.477 mm. At autopsy 35 days after infection: worms from albino mice (4 having a mean weight of 20 grams) had a mean length of 3.514 mm.; worms from albino rats (5 having a mean weight of 282 grams) had a mean length of 4.330 mm. In each comparison the P value for the difference in length is less than 0.01. Therefore, host species has an effect on rate of growth of *Postharmostomum helicis*.

119. *Notes on the Life History of* Fibricola texensis *Chandler, 1942, in Florida.* W. Henry Leigh, University of Miami.

Many of the frogs, *Rana pipiens sphenocephala,* collected from the Everglades region of South Florida, are heavily infected with a diplostomulum type larva. Encapsulated larvae fed to chicks, mice, rats and hamsters develop into strigeids which closely resemble *Fimbricola texensis,* Chandler, 1942.

The distribution of vitellaria, on which so much emphasis has been placed in this genus, varies from the condition described for *F. texensis* to that described for *F. lucida* (LaRue and Bosma, 1927). Vitellaria in the forebody extend anteriorly to the branching of the intestine in some forms and to the level of the middle of the pharynx in others. In some specimens from the rat the vitellaria do not reach the bifurcation of the intestine. In the hindbody the vitellaria extend considerably posterior to the level of the posterior testis, differing from the condition in *F. texensis* and *F. lucida.*

Chandler (1942) reported that the diplostomulum of *F. texensis* failed to leave the body cavity and migrate to the musculature and that encapsulation did not occur. In most of the frogs collected locally the larvae were encapsulated but they have been observed free in muscle tissue. It is possible that migration and encapsulation require longer than the two months involved in Chandler's report. Apparently identical larvae have been recovered from local snakes of the genus *Natrix.*

Chandler also failed to get *F. texensis* to grow in the rat. There were no significant differences in size of egg-producing 10-day old adults in hamster, rat and mouse. Day-old chicks carry the infection for 5 days, but eliminate most of the worms by 10 days. (Supported by grant G-4051 from the National Institutes of Health).

120. *Parasites of the Amphibia. Trematoda.* A. C. Walton, Knox College.

The following hosts and/or trematode parasites have been added to the catalog since earlier publication:—1. *Alytes obstetricans* (Europe)—larval *Opisthioglyphe ranae* in tadpoles. 2. "Amphibian" (Japan)—*Mesocoelium minutum.* 3. *Bufo americanus* (U.S.A.)—*Glypthelmins quieta* and *Gorgodera attenuata.* 4. *Ensatina escholtzii oreganus* (U.S.A.)—*Brachycoelium salamandrae.* 5. *Hyla arborea* (Europe)—larval *Opisthioglyphe endoloba* in tadpoles and adults. 6. *Lymnodynastes tasmaniensis* (Australia)—*Cercariae angelae* and *C. natans.* 7. *Ooeidozyga lima* (China)—larval *Encyclometra koreana.* 8. *Polypedates buergeri* (Japan)—*Pleurolobatus lobatus.* 9. *Rana aurora* (U.S.A.)—larval *Metagonimoides oregonensis.* 10. *Rana clamitans* (U.S.A.)—*Cephalogonimus americanus, Gorgoderina simplex, G. translucida* and *Haematoloechus longiplexus.* 11. *Rana esculenta ridibunda* (Africa)—Metacercariae of Joyeux & Gaud, 1945 and *Haematoloechus variegatus.* 12. *Rana grylio* (U.S.A.)—*Gorgodera amplicava* and *Gorgoderina attenuata.* 13. *Rana limnocharis* (China)—larval *Encyclometra koreana.* 14. *Rana palustris* (U.S.A.)—*Glypthelmins quieta* and *Halipegus* sp.? of Bouchard, 1951. 15. *Rana pipiens* (U.S.A.)—larval *Gorgoderina* sp.? of Goodchild, 1950, in tadpoles. 16. *Rana rugulosa* (China)—larval *Encyclometra koreana.* 17. *Rana septentrionalis* (U.S.A.)—*Cephalogonimus americanus, Glypthelmins quieta, Gorgoderina attenuata, G. simplex, G. translucida, Haematoloechus longiplexus, H. medioplexus, H. similiplexus, Halipegus* sp.? of Bouchard, 1951, *Loxogenes arcanum* and *Megalodiscus temperatus.* 18. *Rana sylvatica* (U.S.A.)—*Gorgoderina translucida.* 19. *Rana* spp.? (Guatemala)—*Gorgoderina attenuata* and *G. parvicava.* 20. *Triturus granulosus* (U.S.A.)—*Brachycoelium salamandrae* and *Megalodiscus americanus.* 21. *Triturus palmatus* (Europe)—larval forms of *Brahycoelium salamandrae, Paralepoderma brumpti, P. cloacicola* and *P. progeneticum* in tadpoles and adults. 22. *Triturus viridescens* (U.S.A.)—*Gorgoderina translucida.*

127. *Human Cysticercosis in the United States.* Maurice Campagna, Louisiana State Board of Health; Clyde Swartzwelder, Louisiana State University School of Medicine; and Edward O. Comer, Veterans Administration Hospital, New Orleans, Louisiana.

Apparently no review of the reported cases of cysticercosis which have been diagnosed in residents or nationals of the United States has been published. The recent observation of two patients with cysticercosis in Louisiana and the report of the prevalence of this infection in U.S. Army personnel during World War II have prompted the preparation of this review. Forty cases of cysticercosis diagnosed in residents or citizens of the United States have been recorded in the available literature since 1857. The two cases described in this paper bring the total to 42. Several other cases reported as cysticercosis have not been included because of insufficient evidence to substantiate the diagnosis. Twenty-seven of the patients in the series were males and 14 were females. The sex of one patient was not stated. Cysticerci were detected in the following general locations: brain, 20 cases; subcutaneous tissues or musculature, 13; eye, 13; and spinal cord, 2 cases. In only 3 of the 42 cases was there indisputable recorded evidence that the infections were acquired in the United States. One of the 2 new cases occurred in a colored male, about 80 years of age, who had never been out of Louisiana. The second infection was in a male patient, 38 years of age, who was experiencing epileptiform seizures. It was probably acquired in Louisiana. The diagnosis of cysticercosis in these 2 patients was based upon both x-ray evidence and excision of calcified bodies, located in the musculature, which were compatible with cysticerci.

122. *Renal Coccidiosis of Canada Geese.* Marion M. Farr. Animal Disease and Parasite Research Branch, A.R.S., U.S.D.A., Beltsville, Maryland.

During the past 5 years an investigation into the causes of sickness and death among Canada geese has been carried out in cooperation with the U.S. Fish and Wildlife Service. Since renal coccidiosis, due to *Eimeria truncata,* can produce emaciation and a high percentage of mortality among domestic geese, it was suspected, among other diseases, to be a cause of morbidity and death among Canada geese. Between 1949 and 1954, 151 of 450 healthy, sick, dead, or dying geese were found to be infected with kidney coccidia. Sixty-eight percent of these infections were light and 32% moderate to heavy. Of the 369 birds examined between 1951 and 1954, 110 were very thin or emaciated and 72 of these thin birds were infected with kidney coccidia. Of the 54 birds which had moderate to heavy infections, 46 were in poor condition.

AMERICAN SOCIETY OF PARASITOLOGISTS

IN MEMORIAM

HERMAN R. SHELANSKI

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Minutes of the 43rd Meeting of the Council and the 28th Annual Meeting of the American Society of Parasitologists were published in the February, 1954 issue of the Journal of Parasitology, vol. 40, pp. 103–111.

Summary of Treasurer's Report for fiscal year, Nov. 1, 1952–Nov. 1., 1953. Complete report on file in the Secretary's office.

1. Balance on hand, Nov. 1, 1952	$ 4,814.53		
2. Collections from all sources, Nov. 1, 1952 to Nov. 1, 1953 (includes dues from 800 members and 908 subscriptions as main items)	12,854.57		
		Total	$17,669.10
3. Total Expenditures (includes 2 nos. Vol. 38 and 4 nos. and supplement of Vol. 39 as main items)			13,672.34
4. Balance on hand, Nov. 1, 1953			$ 3,996.76

Robert M. Stabler, Treasurer

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Allen McIntosh, E. W. Price } Special auditing committee appointed by the Council

THE AMERICAN SOCIETY OF PARASITOLOGISTS

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(2-yr. term expires June 30, 1956)
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Editorial Board of the Journal of Parasitology

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1957 William W. Cort, University of North Carolina
1957 Horace W. Stunkard, New York University
1956 Eloń E. Byrd, University of Georgia
1956 G. Robert Coatney, National Institutes of Health
1956 William L. Jellison, U. S. Public Health Service
1955 Allen McIntosh, Agricultural Research Service, U.S.D.A.
1955 Louis J. Olivier, National Institutes of Health
1955 Norman R. Stoll, Rockefeller Institute for Medical Research
1954 Raymond M. Cable, Purdue University
1954 Lloyd A. Spindler, Agricultural Research Service, U.S.D.A.
1954 Martin D. Young, U. S. Public Health Service

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Wilford S. Bailey

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(3-yr. term expires 1956)

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1953	Cornelius B. Philip	Harold W. Brown

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Donald V. Moore	1953–	Lloyd E. Rozeboom	1954

* Deceased

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H. W. Stunkard	1944–47; 1949–53
W. W. Cort	1948
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G. F. Otto	1952–53
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Horace W. Stunkard, *Chairman*	1944–47; 1949–53
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Cornelius B. Philip	1951–53; 1954–
George R. LaRue, *Chairman*	1954–
Clay G. Huff	1954–

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C. A. Kofoid*	1932–34; 1935–38
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J. E. Ackert	1932–35
R. P. Strong*	1932–35; 1936–39
F. C. Bishopp	1932-36
G. R. LaRue	1932–36
D. H. Wenrich	1932–36; 1938–41
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O. R. McCoy	1936–39
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J. F. Kessell	1937–40
H. J. Van Cleave*	1937–40
W. W. Cort	1938–41; 1942–45; 1946–47; 1949; 1950–53; 1954–
C. B. Philip	1939–42; 1950
E. R. Tyzzer	1939–42
H. W. Brown	1940–43
H. W. Manter	1940–43
R. D. Manwell	1940–43
R. P. Hall	1941–44
E. H. Hinman	1941–44
J. F. Mueller	1941–44
Harold Kirby, Jr.*	1942–45; 1951–52
B. J. Chitwood	1943–46
Rudolf Glaser*	1943–46
P. P. Levine	1943–46
L. T. Coggeshall	1944–47
J. T. Lucker	1944–47; 1950–53
N. R. Stoll	1944–47; 1948–51; 1952–
W. L. Jellison	1945–48; 1949–52; 1953–
C. W. Rees	1945–48
L. A. Spindler	1945–48; 1951–54
R. M. Cable	1946–49; 1951–54
L. E. Rozeboom	1946–49
R. J. Porter	1947–50
William Trager	1947–50
A. C. Walton	1947–50
G. H. Wharton	1948–51
E. E. Byrd	1949–52; 1953–
G. R. Coatney	1949–52; 1953–
M. D. Young	1951–54
Allen McIntosh	1952–
L. J. Olivier	1952–
William Balamuth	1953; 1954–
H. W. Stunkard	1954–

* Deceased

List of Meeting Places

1925	Kansas City	1933	Boston	1941	Dallas	1948	New Orleans
1926	Philadelphia	1934	Pittsburgh	1942	New York (cancelled)	1949	New York
1927	Nashville	1935	St. Louis	1943	(No meeting)	1950	Cleveland
1928	New York	1936	Atlantic City	1944	Cleveland	1951	Chicago
1929	Des Moines	1937	Indianapolis	1945	St. Louis	1952	Ithaca
1930	Cleveland	1938	Richmond	1946	Boston	1953	Madison
1931	New Orleans	1939	Columbus	1947	Chicago	1954	Memphis
1932	Atlantic City	1940	Philadelphia				

AMERICAN SOCIETY OF PARASITOLOGISTS MEMBERSHIP LIST AS OF JULY 15, 1954[1]

LIFE MEMBERS

	Date Elected
Pearse, Arthur S.—Zoology Department, Duke University, Durham, North Carolina	1952
Riley, William A.—2245 Carter Avenue, St. Paul 8, Minnesota	1953
Scott, John W.—1409 Garfield Street, Laramie, Wyoming	1953
Tyzzer, Ernest E.—175 Water Street, Wakefield, Massachusetts	1953

FOREIGN HONORARY MEMBERS

Bacigalupo, Juan—Facultad de Medicina, Buenos Aires, Argentina	1941
Baer, Jean G.—Zoological Institute, University, Neuchatel, Switzerland	1952
Baylis, Harry A.—British Museum (Natural History), Cromwell Road, London, S.W. 7, England	1932
Covell, Maj. Gen. Sir Gordon.—Malaria Laboratory, Horton Hospital, Epsom, Surrey, England	1952
Martini, Eric—Institut für Schiffs- und Tropenkrankheiten, Hamburg, Germany	1932
Rodhain, Jerome A. H.—Institute of Tropical Medicine "Prince Leopold," Antwerp, Belgium	1952
Sergent, Edmond—l'Institut Pasteur d'Algerie, Algerie, North Africa	1932
Sergent, Etienne—l'Institut Pasteur d'Algerie, Algerie, North Africa	1932
Shortt, Henry E.—London School of Hygiene and Tropical Medicine, Gower Street, London, England	1948
Swellengrebel, Nicholaas H.—Institute for Tropical Hygiene, Mauritskade 57, Amsterdam, Netherlands	1939
Travassos, Lauro P.—Instituto Oswaldo Cruz. Rio de Janeiro, Brazil	1938
Vogel, Hans—Institut für Schiffs- und Tropenkrankheiten, Hamburg, Germany (Active Member since 1931)	1952

ACTIVE MEMBERS

Abdel-Malek, Emile T.—Department of Parasitology, University College of Khartoum, Gordon Memorial College, Box 321, Khartoum, Sudan, Africa	1949
Ackert, James E.—Kansas State College of Agriculture, Manhattan, Kansas	
Adams, J. Alfred—New York State Agricultural Experiment Station, Cottage Road, Poughkeepsie, New York	1934
Adams, James R.—Department of Zoology, University of British Columbia, Vancouver, British Columbia, Canada	1948
Alexander, Claude G.—Department of Zoology, University of California, Los Angeles 24, California	1952
Alger, Nelda E.—111 E. 26th St., Apt. D-9, New York, New York	1953
Alicata, Joseph E.—University of Hawaii, College of Agriculture, Honolulu, T.H.	1929
Alicna, Adriano D.—4419 B, Ballard Avenue, Fort Knox, Kentucky	1953
Allen, Rex W.—P.O. Box 518, State College, New Mexico	1942
Allison, Leonard N.—State Fish Hatchery, Grayling, Michigan	1934
Alvarez, Daniel A., Jr.—Avellaneda 285, Box 44, Camaguey, Cuba	1949
Alvarez, Julio—P.O. Box 887, Aguirre 414, Guayaquil, Ecuador, South America	1948
Alves Meira, Joao—Rua Atlantica 481, Sao Paulo, Brazil, South America	1945
Ameel, Donald J.—Department of Zoology, Kansas State College, Manhattan, Kansas	1927
Amrein, Yost U.—346 Harvard Avenue, Claremont, California	1950
Anastos, George—Department of Zoology, University of Maryland, College Park, Maryland	1953
Anderson, Cyrus V.—J. R. Watkins Co., Winona, Minnesota	1940
Anderson, Dorcas J.—Kent State University, Kent, Ohio	1944
Anderson, Everett—3209 Sampson Street, Houston 4, Texas	1952
Anderson, Marlowe G.—New Mexico State College of Agriculture and Mechanical Arts, State College, New Mexico	1930
Andrews, John S.—10314 Naglee Road, Hillandale, Silver Spring, Maryland	1930

[1] Names of 321 charter members were published in the Journal of Parasitology, Vol. **12**: pp. 170–176, (1926). In the present list the names of charter members are indicated by boldface type. The last complete list of members was published in Section 2 (Supplement) of the October issue, Vol. **37**, 1951.

Andrews, Justin M.—Associate Chief, Bureau of State Services, USPHS, Washington 25, D.C.

ANNERAUX, RALPH F.—Animal Pathology Laboratory, Department of Agriculture, Sacramento, California 1931

ANTHONY, JAMES D.—Wisconsin State College, 3203 Downer Avenue, Milwaukee, Wisconsin 1948

AQUILAR, FRANCISCO J.—Colonia 25 de Junio, 14 Av. 23-35, Guatemala City, Guatemala, Central America 1954

ARAI, HISAO P.—16303 S. Dalton Avenue, Gardena, California 1953

ARANT, FRANK S.—Zoology and Entomology Department, Alabama Polytechnic Institute, Auburn, Alabama 1939

ARNER, SISTER JOSEPH MARIE—Incarnate Word College, San Antonio 9, Texas 1948

ARNOLD, JOHN G., JR.—Department of Biology, Loyola University, New Orleans 18, Louisiana 1934

ARZIGIAN, SIMON—Apartment A-4, 1388 Tuckerman St., N.W. Washington 11, D.C. 1953

ATCHLEY, FLOYD O.—Newton Field Station, USPHS, Newton, Georgia 1932

Augustine, Donald L.—Department of Tropical Public Health, Harvard School of Public Health, Boston 15, Massachusetts

AUGUSTSON, GEORGE F.—820 South Street, Madera, California 1941

AXMAN, SISTER M. CLAUDINE—Sacred Heart College, 3100 McCormick Avenue, Wichita 12, Kansas 1948

BABERO, BERT B.—Department of Zoology, Vivarium Building, University of Illinois, Champaign, Illinois 1950

BACHMAN, GEORGE W.—Brookings Institution, 722 Jackson Place, N.W., Washington 6, D.C. 1926

BAILEY, WILFORD S.—School of Veterinary Medicine, Alabama Polytechnic Institute, Auburn, Alabama 1947

BAIR, THOMAS D.—Department of Physiology, Albany Medical College, Albany 8, New York 1952

BAKER, DONALD W.—New York State Veterinary College, Cornell University, Ithaca, New York 1932

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